Statewide Water Conservation

Quantification Project

Texas Water Development Board Research Project

Prepared by Averitt & Associates, Inc.

August 2017

Acknowledgements

The authors of this report wish to sincerely thank the many people that assisted with the compilation of this report.

Many busy water utility staff took time to learn about the project and spent time gathering the data that was fundamental to the development of this report. We recognize and acknowledge their efforts.

The good folks at the wholesale water providers helped us in many ways including outreach to their retail customers, data collection, and by providing invaluable background information. Efforts were coordinated with wholesalers who have shown a serious commitment to municipal water conservation.

The professional staff at the Texas Water Development Board were assisting every step of the way. Guidance and technical support were provided throughout the entire project. The assistance provided was invaluable.

The regional planning groups assisted by giving the authors an audience to explain the project across the state, and by helping with outreach.

The authors learned a tremendous amount during the course of preparing this report. Many organizations were consulted that have a vested interest in water conservation in Texas. Some of these groups are the Alliance for Water Efficiency, the Texas Water Foundation, the Water Conservation Advisory Council, the Lone Star Chapter of the Sierra Club, and many others. The combined experience and knowledge of these groups led to a deeper understanding of the nature of conservation activities in our state.

The report was greatly enhanced thanks to the input from all of those who took an interest.

Statewide Water Conservation Quantification Project

Table of Contents

State Report

Appendix:

List of Tables

State Report

List of Regional Reports

List of Individual Reports

Irving
Kaufman
Keller
Lancaster
Little Elm
Mabank
McKinney
Mesquite
Midlothian
Mountain Peak SUD
North Richland Hills
Plano
Richardson
Rockwall
Sachse
Saginaw
Sardis-Lone Elm WSC
Seagoville
Sherman
Southlake
Springtown
Terrell
The Colony
Tioga
Trophy Club
University Park
Van Alstyne
Watauga
Weatherford
Wortham
Wylie

Region D
Texarkana

Region E
Horizon Regional MUD
El Paso

Region F
Andrews
Ballinger
Brady
Coleman
Junction
Midland

Odessa
San Angelo
Snyder
Winters

Region G
Abilene
Bethesda WSC
Brenham
Brushy Creek MUD
Bryan
Burleson
Cedar Park
Chisholm Trail SUD
College Station
Georgetown
Groesbeck
Hewitt
Kempner WSC
Lampasas
Leander
Possum Kingdom WSC
Robinson
Round Rock
Sweetwater
Temple
Waco
Woodway

Region H
Baytown
Clute
Conroe
Deer Park
Friendswood
Galveston
Houston
Humble
Huntsville
Jersey Village
Katy
Lake Jackson
League City
Pasadena
Pearland
Southern Montgomery County MUD

Stafford
Sugarland
The Woodlands
West University Place
Willis

Region J
Del Rio
Kerrville

Region K
Austin
Aqua WSC
Horseshoe Bay
Johnson City
Llano
Pflugerville
Travis County WCID #10
West Travis County Public Utility Agency

Region L
Alamo Heights
Atascosa Rural WSC
Crystal Clear WSC
Hondo
New Braunfels
Sabinal
San Antonio Water System
San Marcos
Universal City
Uvalde
Victoria

Region M
Agua SUD
East Rio Hondo WSC
Edinburg
Hidalgo County MUD #1
Laredo
McAllen
Mission
North Alamo WSC
Olmito WSC
Pharr
San Juan
Sharyland WSC

Union WSC
Weslaco
Zapata County Waterworks

Region N
Nueces County WCID #3
Corpus Christi

Region O
Brownfield
Lamesa
Levelland
Lubbock
Seminole
Silverton

Region P
El Campo

Statewide Water Conservation Quantification Project
State Report • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Project Approach

The project team completed these steps to address each task:

- Engaged more than 230 water utilities to participate
- Interviewed and collected data from 170 utilities that ultimately participated
- Measured and quantified more than 547 individual conservation activities
- Produced 170 individual reports that included quantified activity savings, water loss reduction savings, individual conservation goal assessment, state water plan goal assessment, and suggested activities that are attainable and meet state water plan goals in the future

- Produced 15 regional reports that detail each region's progress in meeting the recommended regional water plan conservation goals
- Produced one state report summarizing the results of the project

1.2 Key Findings

- Participating utilities make up more than 17,000,000 in population by 2020, which is more than 58 percent of the state's total projected 2020 population.
- Participating utilities make up 77.5 percent of the state's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of 170 participating water utilities in place—and without further enhancement—Texas is projected to exceed its recommended 2020 water conservation supply volume by 95,947 acre-feet per year.
- Nine out of 15 regional water planning areas surveyed are also projected to exceed their 2020 supply volumes.
- These conservation savings estimates will fall short of the state's 2030 supply volume by 7,670 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of 170 participating water utilities in place—and without further enhancement—these 170 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 136,981 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2040 supply volume by 44,409 acre-feet per year, but will fall short of their 2050 volume by 6,409 acre-feet per year.
- Considering only participating utilities' supply volumes, 14 out of 15 regional water planning areas surveyed are projected to exceed their 2020 supply volumes.
- Of those utilities surveyed, the state averages 3.2 measurable conservation activities performed per utility
- Utilities with greater than 100,000 people average 5.9 measurable conservation activities, while utilities with less than 50,000 average 2.2 measurable conservation activities
- One activity—an ordinance that permanently limits outdoor watering to twice per week or less—is projected to save 112,223 acre-feet per year in 2020 by the 46 utilities that have adopted it.

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

1.3 Observations

This report acknowledges that there are many facets involved in the state water planning process that are designed to ensure that Texans have enough water in the future, namely that demands and water management strategies are based on dry-year or drought of record conditions. It is also clear that for most water management strategies in the State Water Plan, the current planning methods are the most logical and effective way to address needs (potential shortages) that will arise in the future.

However, the way water management strategy (WMS) supply volumes for municipal conservation are developed do not facilitate an easy assessment by the utilities expected to meet these future supply volumes.

For instance, WMS supply volumes in regional water plans are derived from making incremental reductions to a municipal water user group's (WUG) starting point regional water planning gallons per capita per day (GPCD)[2] value each year until a certain GPCD value is reached.

But a city or utility looking at its regional water plan cannot easily assess what the starting point GPCD—or the formula used produce that GPCD value—was to derive its WMS supply volume. If utilities are recommended to achieve these volumes, this makes it difficult for a utility to realistically track its progress versus the plan.

Meanwhile, utilities are tracking total GPCD progress on their own, but are using a different GPCD formula[3] when they submit 5- and 10-year goals as required in the TWDB's water conservation plan annual reports and five-year water conservation plans.

From engaging with utilities with limited staff and resources, it was also evident that comparing whether an acre-feet per year supply volume is being met is difficult when the utility reports and operates using gallons.

Lastly and perhaps most crucially, the decision makers at utilities (i.e. reporting entities) that are responsible for affecting conservation policy and implementing activities aimed at meeting WMS supply volumes are sometimes different than those that would be able to affect conservation for WUGs (or political subdivisions). For example, some municipal utility districts operate within city boundaries and, indeed, serve cities, but are not required to carry out any conservation activities that a city council may want to pursue. Yet, supply volumes in the plans are still apportioned to such cities or, in the opposite case, are apportioned to municipal utility districts that cannot actually decide whether to pursue conservation efforts to meet such volumes.

---

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[3] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

1.4 Recommendations

The water savings projections from this project are promising, but only represent a current snapshot of how the state is performing in an area that will be crucial for future municipal water needs. A practical method to annually estimate and measure the implementation of conservation activities statewide would be the best solution.

The state should potentially develop a process to standardize and improve bottom-up (as described in Section 5) conservation savings estimates. This approach should provide consistent regional and statewide conservation estimates, and could provide a common data collection and reporting system that state, regional, and local agencies could access and, over time, create a robust database of conservation data (BBC Research and Consulting, 2012). By establishing such a system to annually estimate bottom-up savings to compare with savings results from the top-down approach currently being employed by the state, an understanding of true conservation savings would emerge and should help water planners to gauge conservation on a yearly basis, rather than every five years with much greater uncertainty.

It is possible that such an improved system would allow state water planners to synchronize yearly goals with metrics that match utilities' make up, goal assessment methods, and decision-making structure so that implementation and meeting goals could become seamless.

This report also makes the following recommendations, which are expanded upon in Section 9.

1. Regional Water Planning Groups (RWPGs) can play a vital role to educate, but should not be expected to drive conservation efforts.

2. Wholesale water providers (WWPs) should function as key stakeholders and drivers of monitoring, measuring, and reporting conservation activity to their customer cities and utilities.

3. Consider using a stakeholder group to form a consensus on savings estimates for activities being implemented throughout Texas.

4. Utilities should consider the suggested activities listed in each of the individual reports issued as part of this project.

2 Introduction and Background

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

This percentage, which amounts to 811,224 acre-feet per year by 2070[4], is significant not only because of the sheer volume of water it represents, but also because of the dramatic population influx that is expected in the urban and suburban corridors over the next 50 years. The state water plan estimates that the six most populous regions—Regions C, G, H, K, L, and M—will increase in population by 79.5 percent from 2020 to 2070. In Region C, 29 percent of 2020 water supplies are slated to come from municipal conservation, while in Region L, 13 percent is expected from this strategy (Texas Water Development Board, 2017). That makes conservation, and municipal conservation in particular, an indispensable piece of the water supply puzzle.

Texas prides itself on being a great place to live and work. However, a fundamental key to the success of the state's economic future is the availability of affordable water supplies.

In short, Texas must meet these expected municipal conservation supply volumes in the future or it will eventually have to make them up with much costlier options, such as new reservoirs or securing additional water rights.

So, it is known that municipal conservation is a vital component of the planning process, yet it is one of the most difficult to measure uniformly and assess on a scale larger than one or several utilities. In 2015, the Texas Legislature appropriated funds to the TWDB to fund a research project to address this problem. Among other tasks, the project was charged with measuring and quantifying the municipal water conservation activities being implemented by utilities throughout the state to determine whether recommended supply volumes for municipal conservation are being met.

2.1 Project Objectives

Using legislative language as guidance, the TWDB developed specific tasks for the project. The following tasks were the core components to completing this state report, 15 regional reports (Region I utilities did not meet selection criteria), and 170 individual utility reports:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

[4] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for the whole state are 203,757 acre-feet per year for 2020, 332,799 acre-feet per year for 2030, 434,947 acre-feet per year for 2040, 562,148 acre-feet per year for 2050, and 685,621 acre-feet per year for 2060.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

3 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a WUG refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

3.1 Regional Planning Group Approach to Determining Supply Volumes

Each RWPG is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce GPCD consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD[5] and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not recommend further reductions in GPCD for WUGs once they reach 140 GPCD, while others apply only "advanced conservation" activities once WUGs meet 140 GPCD.

4 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the RWPGs, direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

---

[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

More than 230 utilities were invited to participate and 170 accepted and were part of the results for this project. For a full list of all utilities that were invited and participated by region, see Appendix B.

5 Project Approach

The following question was used as the basis for developing an approach to complete project:

> *How can conservation activity be measured accurately on a large scale to ensure Texas is meeting the marks set out in its State Water Plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to simply compare GPCD consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology and Quantifiable Savings

6.1 Methodology

In order to complete a uniform quantification process, as much relevant data as possible was collected from participating utilities. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes. The results of this process are detailed in Section 7.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[6] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[7] for that year.[8] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before

[6] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[7] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).
[8] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD[10] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[10] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

6.3 Calculating Activity Savings

This study uses four methods meant to estimate conservation savings as accurately as possible over time. The useful life, decay rate, and partial adoption methods were used in conjunction with one another when the attributes of a particular activity (e.g. a device) required it based on supporting savings estimates. The utility demand-based method was applied on its own without interaction from the other three methods employed.

The following explanations separate the methods to illustrate the concepts involved when calculating savings estimates. All annual savings estimates and variables used for each activity are included in each individual utility report completed for this project.

<u>Utility Demand-based Method</u>

The first method estimates savings based on utility demand. Certain activities are estimated to result in a percentage reduction in use for certain targeted customer classes (multi-family customers, e.g.), targeted types of use (indoor use, e.g.), or for the utility's total use.

For this project, if a utility had future demand estimates available through the interview process or its five-year water conservation plan, those projected water supply requirements were used to apply the percentage of reduction the activity is anticipated to accomplish in future years. The State Water Plan's (2017) decadal demand volumes were used to establish annual demand estimates for those utilities that had not estimated demand decades into the future.

Note that savings estimates derived from State Water Plan demand figures may be higher than some derived from utility-supplied demand figures, because, "Texas' state water plans are based on future conditions that would exist in the event of a recurrence of the worst recorded drought in Texas' history—known as the 'drought of record'— a time when, generally, water supplies are lowest and water demands are highest" (Texas Water Development Board, 2017).

For an activity such as an ordinance permanently limiting outdoor watering to two times per week (or less), it is assumed that as demand increases year over year, the savings estimate increases at the same rate. The reasoning is that estimated annual savings are expressed as percentage of the utility's total demand. It follows that while the ordinance remains in place, new customers must abide by the same stipulations and expected demand will continue to be reduced by the same percentage each year (Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015). The savings estimated using this assumption matched closely with the specific estimates made by cities that have measured the effect of such an ordinance in their service areas, such as the cities of Allen, Austin, et al.

Table 6-1 is an example that shows how savings estimates would be derived using this method when savings are estimated to result in eight percent savings of a utility's total demand. Accuracy for any of these methods would be improved if estimates were compared to actual usage throughout an entire analysis year.

Table 6-1. Example of Estimated Savings from Permanent Twice-per-week Outdoor Watering Restriction in Region C.

Year	Population	Demand (MG)	Percent Savings Due to Activity	Estimated Savings Annual Savings (MG)
2012	101,695	6,471	8%	518
2013	102,622	6,657	8%	533
2014	103,550	6,842	8%	547
2015	104,477	7,028	8%	562
2016	105,405	7,214	8%	577
2017	109,780	7,399	8%	592
2018	114,155	7,585	8%	607
2019	118,529	7,771	8%	622
2020	122,904	7,956	8%	636
2021	127,279	8,142	8%	651
2022	130,373	8,327	8%	666
2023	133,467	8,513	8%	681
2024	136,560	8,699	8%	696
2025	139,654	8,884	8%	711
2026	142,748	9,070	8%	726
2027	145,842	9,256	8%	740
2028	148,936	9,441	8%	755
2029	152,029	9,627	8%	770
2030	155,123	9,813	8%	785

Useful Life Method

This method applies 100 percent of an annual savings estimate for the entire useful life of a device or fixture replacement. A device can be defined as a physical object that is installed or otherwise deployed by the utility or utility customer that reduces water use, such as an irrigation controller or rain barrel. A fixture can be defined as a part that is attached to a system of pipes that carries water to a customer, such as a toilet, showerhead, or kitchen faucet. Estimating savings by this method assumes that the device or fixture lasts for the duration of its useful life estimate.

Table 6-2 shows how savings would be estimated for a suburban utility in Region K that has rebated, sold, or otherwise distributed 50-gallon rain barrels within its service area for the years 2012 – 2015. In this example, the utility has deployed 680 barrels in 2012, 548 in 2013, 812 in 2014, and 290 in 2015.

GDS Associates (2002) estimates that a 75-gallon barrel for a suburban utility in this region yields 4.6 gallons per day per barrel, or 1,679 gallons per year per barrel. Because the utility in the example deployed 50-gallon barrels in the service area rather than 75-gallon barrels, a ratio can be used to determine approximate savings for the smaller capacity barrel:

$$\frac{75}{1{,}679} = \frac{50}{X}$$

The savings estimate per 50-gallon barrel per year is thus 1,119 gallons per year. With a useful life of 10 years, the savings remain constant each year for 10 years. As more barrels are introduced into the service area in subsequent years, the savings aggregate while the barrels are still assumed to be useful. If the program is discontinued, savings from this activity will eventually dissipate after the last group of barrels has been in the service area for 10 years.

Table 6-2. Example of Estimated Savings from 50-gallon Rain Barrels in Region K.

	2012	**2013**	**2014**	**2015**	**TOTAL (gallons)**	**TOTAL (MG)**
2012	761,600	0	0	0	761,600	0.8
2013	761,600	613,760	0	0	1,375,360	1.4
2014	761,600	613,760	909,440	0	2,284,800	2.3
2015	761,600	613,760	909,440	324,800	2,609,600	2.6
2016	761,600	613,760	909,440	324,800	2,609,600	2.6
2017	761,600	613,760	909,440	324,800	2,609,600	2.6
2018	761,600	613,760	909,440	324,800	2,609,600	2.6
2019	761,600	613,760	909,440	324,800	2,609,600	2.6
2020	761,600	613,760	909,440	324,800	2,609,600	2.6
2021	761,600	613,760	909,440	324,800	2,609,600	2.6
2022	0	613,760	909,440	324,800	1,848,000	1.8
2023	0	0	909,440	324,800	1,234,240	1.2
2024	0	0	0	324,800	324,800	0.3
2025	0	0	0	0	0	0
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	0	0	0	0	0	0
2029	0	0	0	0	0	0
2030	0	0	0	0	0	0

Annual Decay Rate Method

Table 6-3 demonstrates the next method which estimates full annual savings for the first year of implementation of an activity and then applies an annual decay rate for the following years the activity is useful.

An annual decay rate means that initial estimated savings decrease by a percentage after a year's time due to gradual loss of effectiveness that can occur for a variety of reasons. An outdoor irrigation (or lawn) audit for single-family (SF) customers is one common activity to which a decay rate is attributed. During an on-site audit, utility staff (or a third-party vendor) assesses the customer's current irrigation system and practices, and may adjust irrigation scheduling and timers, provide efficiency tips, perform a catch-can test or a number of other water-reducing actions. Over time, however, some participants may lose interest in continuing behavior learned from the visit or a device, such as an irrigation timer, may cease to function properly and is never replaced by the customer. While not perfect, applying annual decay rates helps to account for these decreases in savings that have been documented in field studies.

According A&N Technical Services (2005), some audits include an indoor component as well as an outdoor component. In addition, different savings result from lawn audits performed for customers with an irrigation timer than for those without one. For this estimate, unless specific savings or customer details were presented, it is assumed that an outdoor-only audit achieves savings of approximately 8,000 gallons per year per audit with an annual decay rate of 20 percent.[11] As with many other activities with decay rates, the study's authors acknowledge "the persistence of water savings from residential [audits] remains a difficult quantity to predict."

In this example, the utility has conducted 398 audits in 2012, 540 in 2013, 365 in 2014, and 495 in 2015. Applying the annual decay rate results in 80 percent of total savings the following year, 60 percent savings the third year, 40 percent savings the fourth year, and 20 percent savings the fifth year. By the sixth year, savings have approached zero.

Similar to the useful life method, as more audits (or units of another activity with a decay rate) are performed in the service area in subsequent years, the savings from previous audits begin to aggregate when there is overlap over time.

Table 6-3. Example of Estimated Savings from Outdoor Audits (SF).

	2012	2013	2014	2015	TOTAL (gallons)	TOTAL (MG)
2012	3,184,000	0	0	0	3,184,000	3.2
2013	2,547,200	4,320,000	0	0	6,867,200	6.9
2014	1,910,400	3,456,000	2,920,000	0	8,286,400	8.3
2015	1,273,600	2,592,000	2,336,000	3,960,000	10,161,600	10.2
2016	636,800	1,728,000	1,752,000	3,168,000	7,284,800	7.3
2017	0	864,000	1,168,000	2,376,000	4,408,000	4.4
2018	0	0	584,000	1,584,000	2,168,000	2.2
2019	0	0	0	792,000	792,000	0.8
2020	0	0	0	0	0	0

[11] This assumes that 65 percent of savings from a full indoor and outdoor audit comes from the outdoor component (Whitcomb, 2000) (8,000 gallons per year), or if the audit was strictly an outdoor irrigation audit, that 70 percent of savings came from customers with an irrigation timer while 30 percent of savings came from those without one (7,953 gallons per year). The 20 percent decay rate was an assumption selected from a range of possible decay rates for measures within the activity, which incorporated indoor and outdoor elements and sourced several field studies.

Savings Based on Partial Adoption of Activity Method

The fourth method uses the principles of the useful life and decay rate methods, but also factors in an assumption that market penetration—or the adoption of a given activity by customers in the service area—is less than 100 percent.

For example, if a utility reports that 100 take-home water-saving device kits were distributed in a service area in a given year, but a supporting study indicates that the general adoption (or utilization in this case) rate of the kits is 15 percent, then savings would only be estimated for 15 kits out of the 100 distributed. If applicable, normal useful life and decay rates would also apply over time, and savings would aggregate as the useful life of the units overlap in consecutive years.

6.3.1 General formulas used for activity savings

Because not every estimated savings result from field studies will agree with one another—indeed, many studies use an average of multiple results—the following is a presentation of the general formulas used for the activities quantified during this project. Some savings estimates are affected by regional, utility, vendor, weather, time-of-year, or other differences. In addition, savings estimates may be refined or adjusted as new technologies become available or a particular activity is further analyzed.

By using the methods and general formulas in Section 6, utilities interested in quantifying similar activities can substitute annual savings, percentage savings, useful life, and decay rate estimates as they see fit. To see the actual savings estimates and variables used to quantify each utility, refer to Section 3 of any individual report.

Utility Demand-related Activities

Water Savings (MG) = Annual Utility Demand x Percentage Reduction Expected for Activity

Water Savings (MG) = Annual Utility Demand for Type of Use x Percentage Reduction Expected for Activity

Water Savings (MG) = Annual Utility Demand for Customer Class x Percentage Reduction Expected for Activity

Useful Life and Decay Rate Activities

First Year: Water Savings (MG) = Activity Annual Savings in Gallons x Number of Units Per Year ÷ 1,000,000

Subsequent Years for Useful Life: Water Savings (MG) = Activity Annual Savings in Gallons x Number of Units Per Year x Annual Decay Rate* ÷ 1,000,000

*if applicable

Partial Adoption Activities

First Year: Water Savings (MG) = Activity Annual Savings in Gallons x Number of Units Per Year x Adoption Rate ÷ 1,000,000

Subsequent Years for Useful Life: Water Savings (MG) = Activity Annual Savings in Gallons x Number of Units Per Year x Adoption Rate x Annual Decay Rate* ÷ 1,000,000

*If applicable

6.3.2 Specific activity savings

Utility Demand-related Activities

1. **Advanced Metering Infrastructure System with Customer Portal**

Percent Reduction in End Use Expected: 1.34 percent of total demand

Based on an average from five studies performed for several sizes of utilities in different parts of the United States, the potential savings estimate assumes that 20 percent of customers actively using the customer portal will save 10 percent of household use[12] (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015).

Residential customers' use is assumed to make up approximately 67 percent of all retail customers' use based on utility profile information submitted to the TWDB, because this was the most common percentage of residential use among participating utilities in the project. Actual customer class demand percentages will vary by utility and were taken into account for utilities that are actually employing this activity. This activity was suggested for all other participating utilities. Meter data management (MDM) and customer portal brands were also given specific savings estimates when a supporting study was available.

2. **Conservation Pricing**

Percent Reduction in End Use Expected: 2.5 percent

To increase confidence level for an activity that has high variability in results, this percentage is conservatively estimated at 50 percent of the benchmark savings value of 5 percent estimated by the U.S. Environmental Protection Agency (U.S. EPA, 1998).

Confidence: Medium

[12] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

3. Twice-a-week Outdoor Watering Restriction Ordinance

Percent Reduction in End Use Expected: Ranges between 2.74 percent and 13.47 percent of total demand based on percentage of outdoor water use by the utility's single-family customers

Using utility-reported annual savings from total municipal use, a Texas Living Waters Project study (Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015) established a link between implementing an ordinance permanently limiting year-round outdoor watering to two times per week (or less) and the percentage of outdoor water use by single-family residential customers. Thirty-eight percent of outdoor use was found to correlate to water savings of eight percent, while 20 percent was found to correlate to nearly four percent. By further relying upon a TWDB study (Hermitte and Mace, 2012) that determined the percentage of outdoor residential water use in Texas for many utilities throughout the state's regional water planning areas, this project developed a range of potential savings. Table 6-4 details ranges used for individual utilities along the scale. Table 6-5 shows averages established to assign savings to a region if a specific utility's outdoor use was unknown.

Confidence: Medium-low

Table 6-4. Potential Percentage Reduction in Total Municipal Use from Permanent Twice-per-week Outdoor Watering Restrictions.

Outdoor Use Percentage of Total Use	Potential Percent Reduction in Total Use with Ordinance	Outdoor Use Percentage of Total Use	Potential Percent Reduction in Total Use with Ordinance
64	13.47	40	8.42
63	13.26	39	8.21
62	13.05	38	8.00
61	12.84	37	7.79
60	12.63	36	7.58
59	12.42	35	7.37
58	12.21	34	7.16
57	12.00	33	6.95
56	11.79	32	6.74
55	11.58	31	6.53
54	11.37	30	6.32
53	11.16	29	6.11
52	10.95	28	5.89
51	10.74	27	5.68
50	10.53	26	5.47
49	10.32	25	5.26
48	10.11	24	5.05
47	9.89	23	4.84
46	9.68	22	4.63
45	9.47	21	4.42
44	9.26	20	4.21
43	9.05	19	4.00
42	8.84	18	3.79

Table 6-5. Average Regional Percentage Reduction in Total Municipal Use from Permanent Twice-per-week Outdoor Watering Restrictions.

Planning Region	Estimated Average Regional Percent Reduction in Total Use with Ordinance
Region A	8.84
Region B	8.42
Region C	8
Region D	7.37
Region E	6.95
Region F	7.58
Region G	7.58
Region H	4
Region I	9.05
Region J	7.79
Region K	6.53
Region L	6.11
Region M	5.05
Region N	4.84
Region O	8.42
Region P	5.05

4. Water Rate Increases

Percent Reduction in End Use Expected: Based on price elasticities related to demand of approximately – 0.20, which translates into a reduction of two percent in water use for a 10 percent increase in price (U.S. EPA, 1998; TWDB, 2013; Whitcomb, 1999).

See Section 6.3.3 for caveats to this activity's savings estimates.

Confidence: Medium-low

Useful Life, Decay Rate, and Partial Adoption Activities

5. Efficient Urinal Installation (1/2 Gallon Per Flush) (ICI)

Annual Savings Estimate: 6,200 gallons per year per fixture or 16.9 gallons per day

Project savings estimate assumes an average of 22.5 flushes per day when replacing high-flow valve urinals. Source study assumes 260 working days per year on average for an Institutional-Commercial-Industrial (ICI) customer using the fixture (A&N Technical Services, 2005).[13]

[13] From the study's authors: "Much of the savings and cost information in this document has been published previously in other sources. Though we are grateful to build on this previous work, the errors that remain are our own." As such, this study serves as a summary of many studies relied upon by the California Urban Water Conservation Council over several years as more activities were analyzed.

Useful life for this fixture is generally 15 years, but savings are assumed to persist.[14]

Confidence: Low due to variability of flushes and working days by type of ICI customer

6. **Turf Replacement with Zero Irrigation Landscape**

Annual Savings Estimate: Gallons per year per rebate determined by establishing a baseline landscape water requirement for the customer base (LWR_1) and subtracting a landscape water requirement for the landscape design introduced (LWR_2)
Useful Life Estimate: 10 years

LWR_1 can be determined using the EPA WaterSense Formula (U.S. EPA, 2017):

$$LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$$

Where:

LWR_H = Landscape water requirement for the hydrozone (gallons/year)
RTM = Run time multiplier, equal to 1/low quarter distribution uniformity
ET_o = Local reference evapotranspiration (inches/year)
K_L = Landscape coefficient for the type of plant in that hydrozone (turf grass – low water requirement assumed for this activity)
R_a = Allowable rainfall, designated by WaterSense as 25 percent of average peak monthly rainfall
A = Area of the hydrozone (square feet)
C_u = Conversion factor (0.6233 for results in gallons)

LWR_2 for this activity is assumed to be zero. Certain landscapes, such as artificial turf, patios, and permeable hardscapes, require no irrigation. Thus, annual savings for this activity will be equal to LWR_1.

Confidence: Medium

7. **High-Efficiency Toilet Replacement Program (SF)**

Annual Savings Estimate: 10,390 gallons per year per fixture or 28.46 gallons per day

The high-efficiency toilet savings estimate for this project results from increasing the annual savings from the replacement of a 3.5 gallons-per-flush (gpf) toilet by an ultra low-flush (ULF) 1.6 gpf model by 23 percent.

The 23 percent takes into account the 1.19 gpf standard deviation that can result each time a 3.5

[14] Plumbing code and efficiency standards effectively make the savings permanent, as equally efficient models will replace these urinals by useful life's end.

gpf toilet is flushed[15] (AWWA Research Foundation, 1999). The volume difference between the 1.6 gpf and 1.28 gpf models is a precise 20 percent, but when adjusted standard deviation of toilet flush volumes is introduced for these models, the difference can be between 20 and 26 percent, or an average of 23 percent. See the ULF toilet replacement activity in this section for details on how estimated savings for the 1.6 gpf model was calculated.

Regarding decay rate or persistence as toilets are used, "[a]t least one field study tested for, and could not detect, any downward trend in the level of water savings amongst early participants in toilet programs..." (A&N Technical Services, 2005). Useful life for this fixture is generally 20 years, but savings are assumed to persist.[16]

Confidence: High

8. High-Efficiency Toilet Replacement Program (MF)

Annual Savings Estimate: 15,756 gallons per year per fixture or 43.17 gallons per day

The high-efficiency toilet savings estimate for multi-family (MF) customers also results from increasing the annual savings from the replacement of a 3.5 gallons-per-flush (gpf) toilet by an ultra low-flush (ULF) 1.6 gpf model by 23 percent. See the ULF toilet replacement (MF) activity in this section for details on how estimated savings for the 1.6 gpf model was calculated. Useful life for this fixture is generally 20 years, but savings are assumed to persist.[17]

Confidence: High

9. High-Efficiency Toilet Replacement Program (ICI)

Annual Savings Estimate: 13,000 gallons per year per fixture or 35.6 gallons per day

The high-efficiency toilet savings estimate for ICI customers results from increasing the annual savings from the replacement of a 3.5 gallons-per-flush (gpf) toilet by an ultra low-flush (ULF) 1.6 gpf model by 23 percent. See the ULF toilet replacement (ICI) activity in this section for details on how estimated savings for the 1.6 gpf model was calculated.

Confidence: High

---

[15] From the end use study: "Results from this research about the variability of toilet flush volumes indicate that toilets do not flush in neat little intervals like 1.6, 3.5, or 5.0 gpf. A toilet rated to flush at 3.5 gpf or 1.6 gpf will seldom use precisely that amount of water for a single flush, even when the toilet is new."
[16] See Footnote 14.
[17] See Footnote 14.

10. High-Efficiency Clothes Washer (SF)

Annual Savings Estimate: 7,030 gallons per year per washer or 19.2 gallons per day

Useful life for this device is generally 11 years (THELMA, 1997), but savings are assumed to persist if useful life ends in 2014 or after.[18] Estimated savings are an average of studies that yielded approximately 5,060 and 9,000 gallons per year per washer (A&N Technical Services, 2005).

Confidence: Medium

11. Kitchen Pre-Rinse Spray Valve Replacement (ICI)

Annual Savings Estimate: 28,280 gallons per year per fixture or 77.48 gallons per day

Useful life for this device is generally 10 years, but savings are assumed to persist if useful life ends in 2013 or after.[19] Estimated savings are an average of studies that yielded approximately 6,560 and 50,000 gallons per year per valve (SBW Consulting, 2007; California Urban Water Conservation Council, 2004).

Confidence: Low due to differences in ICI customer type that may use the valves more heavily

12. Low-Flow Showerhead Replacement (SF)

Annual Savings Estimate: 2,050 gallons per year per fixture or 5.6 gallons per day

Useful life for this fixture is generally five years, but savings are assumed to persist.[20] Estimated savings are an average of 5.5 gallons per day and 5.8 gallons per day with slight downtick due to statistical savings margin (A&N Technical Services, 2005).

Confidence: Medium-high

13. Low-Flow Showerhead Replacement (MF)

Annual Savings Estimate: 1,898 gallons per year per fixture or 5.2 gallons per day (A&N Technical Services, 2005)

Useful life for this fixture is generally five years, but savings are assumed to persist.[21]

Confidence: Medium-high

---

[18] See Footnote 14.
[19] See Footnote 14.
[20] See Footnote 14.
[21] See Footnote 14.

14. Rain Barrels

Annual Savings Estimate: Ranges by barrel capacity and by region

Using ratios based on savings for a 75-gallon barrel, Table 6-6 provides estimates by region to account for different size barrels that may be deployed in service areas. Useful life was conservatively estimated at 10 years, rather than 15 indicated in the source study (GDS Associates, 2002).

Confidence: Low due to rainfall variability

Table 6-2. Estimated Annual Savings per Gallon of Capacity for Rain Barrels by Planning Region.

Region	Savings per Gallon of Capacity
Region A	12.1
Region B	16.5
Region C	20.9
Region D	25.3
Region E	6.3
Region F	11.2
Region G	18.5
Region H	26.8
Region I	22.4
Region J	12.6
Region K	22.4
Region L	17
Region M	13.1
Region N	16
Region O	10.7
Region P	23.9

15. Outdoor Landscape Evaluations (SF)

Annual Savings Estimate: 8,000 gallons per year per audit
Annual Decay Rate: 20 percent

Some audits include an indoor component as well as an outdoor component. In addition, different savings result from lawn audits performed for customers with an irrigation timer than for those without one. For the estimate, unless specific savings or customer details were presented, it was assumed that an outdoor-only audit achieves savings of approximately 8,000 gallons per year per audit with an annual decay rate of 20 percent. This assumes that 65 percent of savings from a full indoor and outdoor audit comes from the outdoor component (Whitcomb, 2000)(8,000 gallons per year), or if the audit was strictly an outdoor irrigation audit, that 70 percent of savings came from customers with an irrigation timer while 30 percent of savings came from those without one (7,953 gallons per year).

The 20 percent decay rate is an assumption based on a range of possible decay rates for measures within the activity, which incorporated indoor and outdoor elements and sourced several field studies. As with many other activities with decay rates, the study's authors acknowledge "the persistence of water savings from residential [audits] remains a difficult quantity to predict" (A&N Technical Services, 2005).

16. Ultra Low Flush Toilet Replacement Program (SF)

Annual Savings Estimate: 8,440 gallons per year per fixture or 23.1 gallons per day per toilet (A&N Technical Services, 2005)

Savings per toilet per day estimated uses the formula:

Savings for Single Family Customer = 6.693 x Persons Per Dwelling – 0.529 x (Persons Per Dwelling)^2 + 7.826

Because multiple, in-depth studies for ULF toilet savings have long been available, ULF annual savings per toilet were used to develop savings estimate for high-efficiency toilets (1.28 gpf) for this project.

The project assumed three people per dwelling for this activity, and that an ULF toilet will be replaced by a high-efficiency model (1.28 gpf) due to current plumbing and efficiency code requirements once useful life of 20 years elapses.

Confidence: High. These estimates are based on rigorous field studies.

17. Ultra Low Flush Toilet Replacement Program (MF)

Annual Savings Estimate: 12,810 gallons per year per fixture or 35.09 gallons per day per toilet (A&N Technical Services, 2005)

Savings per toilet per day estimated uses the formula:

Savings for Multi-family Customer = 19.138 x Persons Per Unit – 0.942 x (Persons Per Unit)^2 + 2.181

Because multiple, in-depth studies for ULF toilet savings have long been available, ULF annual savings per toilet were used to develop savings estimate for high-efficiency toilets (1.28 gpf) for this project.

The project assumes 1.9 people per unit for this activity, and that a high-efficiency model (1.28 gpf) will replace an ULF toilet due to current plumbing and efficiency code requirements once useful life of 20 years elapses.

Confidence: High. These estimates are based on rigorous field studies.

18. Ultra Low Flush Toilet Replacement Program (ICI)

Annual Savings Estimate: 10,580 gallons per year per fixture or 29 gallons per day per toilet (A&N Technical Services, 2005)

The project assumes that ICI customers adopting this activity fall within the multiple use market segment that yields estimated savings of 29 gallons per day per ULF toilet installed. While the confidence interval for this assumption is lower than some other market segments, this estimate accounts for more variability among potential ICI customers.

Because multiple, reliable studies for ULF toilet savings have long been available, ULF annual savings per toilet were used to develop savings estimate for high-efficiency toilets (1.28 gpf) for this project.

Confidence: Medium due to multiple use market segment assumption.

Vendor-specific Activities

19. Save Water Co. Commercial, Multi-family and Hotel Programs

Calculated based on specific reported savings by vendor. See individual reports.

20. WaterWise Take-home Kits

Annual Savings Estimate: 7,384 gallons per year per kit (Frontier Associates, 2015)

Based on utility feedback, the project assumes a conservative adoption rate of 15 percent of all kits distributed through independent school districts, as well as a modest five-year useful life for all items in the kit.

21. W.I.S.E. Guys Audits

Annual Savings Estimate: 8,000 gallons per year per audit (A&N Technical Services, 2005)
Annual Decay Rate: 20 percent

More specific savings estimates were not available directly from the vendor; however, the vendor does perform very similar measures as assessed for savings for in-house utility audits.

6.3.3 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, it was noted that several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.3.4 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.3.5 Limitations to data collection and the interview process

The projections in this report indicate the best information available as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3.6 Discrepancies with regional water plans

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan.

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes split along regional boundaries.

7 Where Does the State Stand in Meeting Its Goals?

The 2017 State Water Plan recommends that Texas should achieve 811,224 acre-feet per year of savings annually to meet the 2070 WMS supply volume for municipal water conservation[22] (Texas Water Development Board, 2017).

The results of this study indicate that the 170 participating utilities surveyed in the state will save an estimated 278,747 acre-feet per year in 2020 and 405,446 acre-feet per year in 2070.[23]

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. Savings estimates from rate increases and water loss reduction are the only activities that are exceptions to these conditions for the reasons covered in Section 6.

If these current activities are maintained, Texas is estimated to exceed the state's adjusted[24] 2020 WMS supply volume of 182,800 acre-feet per year by 95,947 acre-feet per year. The savings from these utilities are estimated to fall short of the 2030 supply volume by 7,670 acre-feet per year, and the 2070 volume of 760,249 acre-feet per year by 354,803 acre-feet per year.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire state's 2070 recommended supply volume for municipal water conservation. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[25] for water loss GPCD[26] and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

---

[22] In an effort to match the Interactive State Water Plan and the planning document itself, the study has maintained the 2070 supply volume at 811,224 acre-feet per year for the entire state. However, in Region M, 50,441 acre-feet per year in 2070 are to be supplied by non-traditional irrigation district-related conservation that is slated to come from existing surplus. This differs from all other regions in the state, which classify municipal water conservation as a demand reduction measure. Thus, Table 7-1 has a 2070 supply volume of 760,249 acre-feet per year, as well as decadal volumes that account for the Region M anomaly. The quantified savings from all regions are compared to these adjusted volumes.

[23] Estimated savings are 298,248 acre-feet per year for 2030, 329,382 acre-feet per year for 2040, 355,555 for 2050, and 380,523 acre-feet per year for 2060.

[24] See Footnote 3 above.

[25] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[26] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total State WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire state.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total State WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the state for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

Table 7-1. Quantified Activity Savings of Participating Utilities Compared to Statewide WMS Supply Volumes.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total State WMS Volume	Unaccounted for Conservation WMS Volume
2015	166,360	48,047	214,408	81,245	133,163
2016	208,663	51,928	260,590	101,555	159,035
2017	220,750	52,631	273,381	101,555	171,826
2018	221,110	53,334	274,444	121,867	152,577
2019	222,505	53,902	276,408	142,178	134,229
2020	224,274	54,473	278,747	182,800	95,947
2021	226,001	55,206	281,206	195,112	86,095
2022	228,103	55,939	284,042	207,424	76,618
2023	229,803	56,672	286,475	219,736	66,739
2024	231,495	57,472	288,967	232,047	56,920
2025	233,225	58,272	291,497	244,360	47,138
2026	232,594	59,056	291,650	256,671	34,979
2027	233,091	59,857	292,948	268,983	23,965
2028	234,057	60,657	294,714	281,294	13,420
2029	235,024	61,457	296,481	293,607	2,875
2030	235,990	62,258	298,248	305,918	(7,670)
2031	238,491	62,910	301,402	315,532	(14,130)
2032	240,995	63,564	304,558	325,145	(20,587)
2033	243,495	64,217	307,711	334,759	(27,048)
2034	245,992	64,875	310,868	344,372	(33,504)
2035	248,457	65,534	313,992	353,986	(39,994)
2036	250,496	66,193	316,689	363,599	(46,910)
2037	252,990	66,852	319,842	373,213	(53,371)
2038	255,509	67,511	323,020	382,826	(59,806)
2039	258,035	68,169	326,204	392,440	(66,236)
2040	260,554	68,828	329,382	402,053	(72,671)
2041	262,664	69,319	331,983	413,738	(81,755)
2042	264,762	69,811	334,573	425,423	(90,850)
2043	266,865	70,303	337,168	437,108	(99,940)
2044	268,960	70,802	339,762	448,793	(109,031)
2045	271,061	71,302	342,363	460,478	(118,115)
2046	273,196	71,801	344,998	472,163	(127,165)
2047	275,338	72,301	347,639	483,848	(136,209)
2048	277,480	72,800	350,280	495,533	(145,253)
2049	279,618	73,300	352,918	507,218	(154,300)
2050	281,757	73,799	355,555	518,903	(163,348)
2051	283,620	74,427	358,047	531,080	(173,033)
2052	285,483	75,056	360,539	543,258	(182,719)
2053	287,343	75,685	363,028	555,435	(192,407)
2054	289,203	76,323	365,526	567,613	(202,087)
2055	291,067	76,960	368,027	579,791	(211,763)
2056	292,924	77,598	370,522	591,968	(221,445)
2057	294,781	78,236	373,017	604,146	(231,128)
2058	296,647	78,874	375,521	616,323	(240,801)
2059	298,511	79,512	378,023	628,501	(250,478)
2060	300,374	80,149	380,523	640,678	(260,155)
2061	302,184	80,823	383,007	652,635	(269,628)
2062	303,992	81,496	385,488	664,592	(279,105)
2063	305,799	82,170	387,969	676,549	(288,580)
2064	307,609	82,855	390,464	688,507	(298,043)
2065	309,420	83,540	392,960	700,464	(307,504)
2066	311,233	84,225	395,458	712,420	(316,962)
2067	313,044	84,910	397,954	724,378	(326,424)
2068	314,854	85,595	400,449	736,335	(335,885)
2069	316,665	86,280	402,945	748,292	(345,347)
2070	318,478	86,969	405,446	760,249	(354,803)

Table 7-2 shows how the state's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 170 participating utilities. These utilities constitute approximately 58 percent of the state's population and account for 77.5 percent of this water management strategy.

In this comparison, the utilities' savings are estimated to exceed the 2040 supply volume by 44,409 acre-feet per year, but just fall short of the 2050 supply volume by 6,409 acre-feet per year. Full regional tables in the same format as Table 7-2, can be found in Appendix A. The following definitions pair with the column headers in Table 7-2.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[27] for water loss GPCD[28] and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plans for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the state water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

---

[27] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[28] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Table 7-2. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	166,360	48,047	214,408	48,806	14,201	63,007	151,401
2016	208,663	51,928	260,590	61,007	17,751	78,759	181,832
2017	220,750	52,631	273,381	61,007	21,301	82,309	191,072
2018	221,110	53,334	274,444	73,209	24,852	98,061	176,383
2019	222,505	53,902	276,408	85,409	28,402	113,811	162,597
2020	224,274	54,473	278,747	109,813	31,952	141,766	136,981
2021	226,001	55,206	281,206	116,864	32,959	149,823	131,383
2022	228,103	55,939	284,042	123,915	33,966	157,881	126,161
2023	229,803	56,672	286,475	130,965	34,973	165,938	120,536
2024	231,495	57,472	288,967	138,016	35,980	173,996	114,971
2025	233,225	58,272	291,497	145,067	36,987	182,054	109,443
2026	232,594	59,056	291,650	152,117	37,994	190,111	101,539
2027	233,091	59,857	292,948	159,168	39,001	198,169	94,779
2028	234,057	60,657	294,714	166,218	40,008	206,227	88,487
2029	235,024	61,457	296,481	173,269	41,015	214,284	82,197
2030	235,990	62,258	298,248	180,318	42,023	222,341	75,906
2031	238,491	62,910	301,402	187,275	41,330	228,605	72,796
2032	240,995	63,564	304,558	194,230	40,638	234,868	69,690
2033	243,495	64,217	307,711	201,185	39,946	241,131	66,580
2034	245,992	64,875	310,868	208,141	39,254	247,394	63,473
2035	248,457	65,534	313,992	215,096	38,561	253,657	60,334
2036	250,496	66,193	316,689	222,051	37,869	259,920	56,769
2037	252,990	66,852	319,842	229,006	37,177	266,183	53,659
2038	255,509	67,511	323,020	235,962	36,485	272,446	50,574
2039	258,035	68,169	326,204	242,917	35,792	278,709	47,495
2040	260,554	68,828	329,382	249,869	35,100	284,969	44,409
2041	262,664	69,319	331,983	257,107	35,565	292,672	39,312
2042	264,762	69,811	334,573	264,342	36,029	300,371	34,202
2043	266,865	70,303	337,168	271,576	36,494	308,070	29,098
2044	268,960	70,802	339,762	278,811	36,958	315,770	23,992
2045	271,061	71,302	342,363	286,046	37,423	323,469	18,894
2046	273,196	71,801	344,998	293,281	37,888	331,168	13,829
2047	275,338	72,301	347,639	300,516	38,352	338,868	8,771
2048	277,480	72,800	350,280	307,750	38,817	346,567	3,713
2049	279,618	73,300	352,918	314,985	39,281	354,267	(1,348)
2050	281,757	73,799	355,555	322,246	39,746	361,992	(6,409)
2051	283,620	74,427	358,047	330,411	39,746	370,157	(12,110)
2052	285,483	75,056	360,539	338,602	39,747	378,348	(17,809)
2053	287,343	75,685	363,028	346,793	39,747	386,540	(23,512)
2054	289,203	76,323	365,526	354,984	39,747	394,731	(29,205)
2055	291,067	76,960	368,027	363,175	39,748	402,922	(34,895)
2056	292,924	77,598	370,522	371,366	39,748	411,114	(40,591)
2057	294,781	78,236	373,017	379,557	39,748	419,305	(46,288)
2058	296,647	78,874	375,521	387,748	39,748	427,496	(51,975)
2059	298,511	79,512	378,023	395,939	39,749	435,688	(57,665)
2060	300,374	80,149	380,523	404,154	39,749	443,903	(63,356)
2061	302,184	80,823	383,007	411,731	39,639	451,370	(68,363)
2062	303,992	81,496	385,488	419,333	39,528	458,861	(73,373)
2063	305,799	82,170	387,969	426,934	39,418	466,352	(78,384)
2064	307,609	82,855	390,464	434,536	39,308	473,843	(83,379)
2065	309,420	83,540	392,960	442,137	39,198	481,335	(88,375)
2066	311,233	84,225	395,458	449,738	39,087	488,826	(93,367)
2067	313,044	84,910	397,954	457,340	38,977	496,317	(98,363)
2068	314,854	85,595	400,449	464,941	38,867	503,808	(103,359)
2069	316,665	86,280	402,945	472,543	38,756	511,299	(108,354)
2070	318,478	86,969	405,446	480,143	38,646	518,789	(113,342)

Table 7-3 lists the number of utilities in the state estimated to be meeting or not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the state as a whole.

Table 7-3. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
A	Meeting	4	985	4	1,079	4	1,206	4	1,335	4	1,468	4	1,614
	Not Meeting	2	(707)	2	(770)	2	(835)	2	(898)	2	(961)	2	(1,029)
	Total Region A	6	278	6	309	6	371	6	437	6	507	6	585
B	Meeting	1	961	1	1,056	1	1,125	1	1,186	1	1,277	1	1,362
	Not Meeting		0		0		0		0		0		0
	Total Region B	1	961	1	1,056	1	1,125	1	1,186	1	1,277	1	1,362
C	Meeting	52	72,947	50	58,509	47	68,854	45	74,606	42	78,587	43	84,588
	Not Meeting	11	(1,953)	13	(2,789)	16	(5,766)	18	(7,789)	21	(7,483)	20	(8,742)
	Total Region C	63	70,994	63	55,720	63	63,088	63	66,807	63	71,104	63	75,846
D	Meeting		0		0		0		0		0		0
	Not Meeting	1	(4,945)	1	(5,169)	1	(5,311)	1	(5,240)	1	(5,227)	1	(5,226)
	Total Region D	1	(4,945)	1	(5,169)	1	(5,311)	1	(5,240)	1	(5,227)	1	(5,226)
E	Meeting	1	13,875	1	14,056	1	15,980	1	15,661	1	13,796	1	14,489
	Not Meeting	1	(348)	1	(332)	1	(338)	1	(408)	1	(473)	1	(535)
	Total Region E	2	13,527	2	13,724	2	15,642	2	15,253	2	13,323	2	13,954
F	Meeting	5	5,039	5	5,457	5	5,882	5	6,365	5	6,895	5	7,441
	Not Meeting	5	(473)	5	(521)	5	(585)	5	(639)	5	(695)	5	(779)
	Total Region F	10	4,566	10	4,936	10	5,297	10	5,726	10	6,200	10	6,662
G	Meeting	11	6,364	6	3,927	5	3,968	4	3,434	4	3,976	4	4,557
	Not Meeting	10	(4,474)	15	(14,780)	16	(25,691)	17	(36,426)	17	(46,950)	17	(54,737)
	Total Region G	21	1,890	21	(10,853)	21	(21,723)	21	(32,992)	21	(42,974)	21	(50,189)
H	Meeting	18	27,208	14	14,249	14	13,040	10	12,251	10	12,455	9	12,946
	Not Meeting	3	(719)	7	(3,027)	7	(16,349)	11	(30,119)	11	(39,136)	12	(47,908)
	Total Region H	21	26,489	21	11,222	21	(3,309)	21	(17,868)	21	(26,681)	21	(34,962)
J	Meeting	1	1,461	1	1,559	1	1,657	1	1,758	1	1,853	1	1,948
	Not Meeting	1	(324)	1	(330)	1	(337)	1	(343)	1	(345)	1	(350)
	Total Region J	2	1,137	2	1,229	2	1,320	2	1,415	2	1,508	2	1,598
K	Meeting	4	14,513	2	17,241	2	19,681	2	21,587	2	23,320	2	25,358
	Not Meeting	4	(2,065)	6	(4,855)	6	(7,298)	6	(10,199)	6	(13,903)	6	(19,151)
	Total Region K	8	12,448	8	12,386	8	12,383	8	11,388	8	9,417	8	6,207
L	Meeting	6	4,157	5	929	4	4,142	3	245	3	181	1	95
	Not Meeting	5	(1,398)	6	(4,066)	7	(8,351)	8	(15,879)	8	(35,338)	10	(51,621)
	Total Region L	11	2,759	11	(3,137)	11	(4,209)	11	(15,634)	11	(35,157)	11	(51,526)
M	Meeting	11	4,751	7	4,071	4	3,308	1	206	0	0	0	0
	Not Meeting	4	(2,678)	8	(9,615)	11	(20,144)	14	(34,128)	15	(53,884)	15	(75,107)
	Total Region M	15	2,073	15	(5,544)	15	(16,836)	15	(33,922)	15	(53,884)	15	(75,107)
N	Meeting	1	1,998		0		0		0		0		0
	Not Meeting	1	(40)	2	(3,000)	2	(6,651)	2	(6,401)	2	(6,501)	2	(6,566)
	Total Region N	2	1,959	2	(3,000)	2	(6,651)	2	(6,392)	2	(6,503)	2	(6,566)
O	Meeting	3	3,007	3	3,268	3	3,538	4	3,847	4	4,165	4	4,465
	Not Meeting	3	(191)	3	(214)	3	(225)	2	(238)	2	(257)	2	(275)
	Total Region O	6	2,816	6	3,054	6	3,313	6	3,609	6	3,908	6	4,190
P	Meeting	1	30		0		0		0		0		0
	Not Meeting		0	1	(27)	1	(91)	1	(183)	1	(176)	1	(179)
	Total Region P	1	30	1	(27)	1	(91)	1	(183)	1	(176)	1	(179)
TEXAS	Meeting	119	157,296	99	125,401	91	142,381	81	142,481	77	147,973	75	158,863
	Not Meeting	51	-20,315	71	-49,495	79	-97,972	89	-148,890	93	-211,329	95	-272,205
	Total Texas	170	136,981		75,906		44,409		(6,409)		(63,356)		(113,342)

Tables 7-4 through 7-7 show how the state's participating utilities, categorized by different population strata, are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The four strata are utilities with fewer than 10,000, between 10,000 and 49,999, between 50,000 and 99,999, and over 100,000 people. These tables contain the sum of the supply volumes for the participating utilities that fit into these population strata.

Table 7-4. Participating Utilities' (Under 10,000) Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	557	(121)	435	247	7	255	180
2016	776	(124)	652	309	9	319	334
2017	790	(121)	669	309	11	320	348
2018	795	(119)	676	371	13	384	292
2019	800	(115)	684	433	15	448	237
2020	805	(112)	693	558	17	574	119
2021	810	(113)	697	599	17	616	81
2022	816	(112)	703	641	17	658	45
2023	821	(113)	709	683	17	700	8
2024	827	(114)	712	726	17	743	(30)
2025	832	(116)	716	768	17	785	(69)
2026	838	(118)	720	810	17	827	(106)
2027	844	(120)	724	852	17	869	(145)
2028	849	(121)	728	895	17	912	(184)
2029	855	(124)	732	937	17	954	(222)
2030	861	(125)	735	979	17	996	(261)
2031	865	(127)	738	1,022	15	1,037	(299)
2032	869	(128)	741	1,064	14	1,078	(338)
2033	873	(129)	744	1,108	12	1,121	(376)
2034	878	(131)	747	1,151	11	1,162	(414)
2035	882	(131)	751	1,194	9	1,203	(452)
2036	886	(131)	754	1,236	8	1,244	(490)
2037	891	(133)	758	1,280	6	1,286	(527)
2038	895	(133)	762	1,323	5	1,328	(566)
2039	899	(133)	766	1,366	3	1,369	(604)
2040	904	(135)	769	1,408	2	1,410	(641)
2041	908	(135)	773	1,455	5	1,461	(687)
2042	913	(136)	778	1,501	9	1,510	(733)
2043	918	(136)	781	1,547	13	1,560	(779)
2044	922	(135)	787	1,592	17	1,609	(822)
2045	927	(133)	793	1,638	21	1,659	(866)
2046	932	(133)	800	1,685	24	1,709	(910)
2047	936	(131)	805	1,731	28	1,759	(954)
2048	941	(129)	811	1,776	32	1,808	(997)
2049	946	(129)	817	1,822	36	1,858	(1,040)
2050	951	(127)	824	1,869	39	1,908	(1,084)
2051	963	(137)	826	1,916	50	1,966	(1,139)
2052	976	(148)	829	1,963	60	2,023	(1,195)
2053	989	(158)	831	2,011	70	2,080	(1,249)
2054	1,002	(167)	835	2,059	80	2,139	(1,304)
2055	1,014	(177)	838	2,106	90	2,196	(1,358)
2056	1,027	(187)	840	2,153	100	2,253	(1,413)
2057	1,040	(197)	843	2,201	110	2,311	(1,468)
2058	1,053	(206)	846	2,248	120	2,368	(1,522)
2059	1,066	(216)	849	2,296	130	2,426	(1,577)
2060	1,078	(226)	853	2,343	140	2,484	(1,631)
2061	1,088	(231)	857	2,394	143	2,537	(1,679)
2062	1,098	(235)	863	2,444	146	2,590	(1,727)
2063	1,108	(239)	869	2,494	149	2,643	(1,774)
2064	1,118	(243)	875	2,545	152	2,697	(1,822)
2065	1,128	(247)	882	2,595	155	2,750	(1,868)
2066	1,138	(250)	889	2,645	158	2,803	(1,914)
2067	1,148	(253)	894	2,695	161	2,856	(1,962)
2068	1,158	(256)	901	2,745	164	2,909	(2,008)
2069	1,168	(260)	908	2,796	167	2,963	(2,054)
2070	1,178	(264)	914	2,846	170	3,016	(2,101)

Table 7-5. Participating Utilities' (10,000 – 49,999) Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	4,566	1,810	6,376	1,926	211	2,137	4,239
2016	5,188	1,836	7,023	2,407	263	2,671	4,352
2017	5,431	1,839	7,270	2,407	316	2,724	4,546
2018	5,461	1,842	7,303	2,889	369	3,258	4,045
2019	5,489	1,844	7,333	3,370	422	3,792	3,541
2020	5,519	1,847	7,366	4,333	474	4,808	2,558
2021	5,573	1,870	7,443	4,602	487	5,090	2,353
2022	5,632	1,892	7,524	4,872	500	5,372	2,153
2023	5,690	1,915	7,605	5,141	513	5,653	1,952
2024	5,748	1,938	7,686	5,410	526	5,935	1,751
2025	5,808	1,961	7,769	5,679	539	6,217	1,552
2026	5,868	1,983	7,852	5,948	551	6,499	1,353
2027	5,928	2,006	7,934	6,217	564	6,781	1,153
2028	5,987	2,029	8,016	6,486	577	7,063	953
2029	6,047	2,052	8,099	6,755	590	7,345	754
2030	6,106	2,074	8,181	7,024	603	7,627	554
2031	6,162	2,092	8,254	7,294	609	7,904	350
2032	6,216	2,110	8,326	7,564	616	8,180	146
2033	6,270	2,128	8,398	7,834	623	8,457	(59)
2034	6,324	2,148	8,472	8,104	629	8,734	(262)
2035	6,377	2,168	8,545	8,375	636	9,010	(466)
2036	6,432	2,187	8,619	8,645	642	9,287	(668)
2037	6,486	2,207	8,693	8,915	649	9,564	(871)
2038	6,539	2,226	8,766	9,185	655	9,840	(1,074)
2039	6,594	2,246	8,840	9,455	662	10,117	(1,276)
2040	6,647	2,266	8,913	9,725	668	10,394	(1,481)
2041	6,708	2,289	8,997	9,997	648	10,645	(1,648)
2042	6,767	2,312	9,079	10,269	628	10,897	(1,818)
2043	6,827	2,335	9,162	10,541	608	11,149	(1,987)
2044	6,885	2,358	9,243	10,813	589	11,401	(2,158)
2045	6,945	2,381	9,326	11,085	569	11,653	(2,327)
2046	7,004	2,404	9,408	11,357	549	11,905	(2,497)
2047	7,064	2,427	9,491	11,628	529	12,157	(2,666)
2048	7,123	2,450	9,572	11,900	509	12,409	(2,837)
2049	7,183	2,473	9,655	12,172	489	12,661	(3,006)
2050	7,242	2,496	9,737	12,444	469	12,913	(3,176)
2051	7,312	2,529	9,840	12,746	479	13,225	(3,385)
2052	7,383	2,562	9,944	13,048	489	13,537	(3,593)
2053	7,453	2,595	10,047	13,350	499	13,849	(3,802)
2054	7,524	2,627	10,151	13,652	509	14,161	(4,010)
2055	7,594	2,660	10,255	13,954	519	14,473	(4,219)
2056	7,663	2,693	10,357	14,256	530	14,786	(4,429)
2057	7,733	2,726	10,460	14,558	540	15,098	(4,638)
2058	7,804	2,759	10,564	14,860	550	15,410	(4,846)
2059	7,876	2,792	10,668	15,162	560	15,722	(5,054)
2060	7,946	2,825	10,771	15,464	570	16,034	(5,263)
2061	8,021	2,869	10,890	15,827	579	16,406	(5,516)
2062	8,096	2,913	11,010	16,191	588	16,779	(5,769)
2063	8,171	2,958	11,128	16,555	596	17,151	(6,023)
2064	8,247	3,002	11,249	16,919	605	17,524	(6,275)
2065	8,322	3,046	11,368	17,283	613	17,896	(6,528)
2066	8,397	3,090	11,487	17,646	622	18,268	(6,781)
2067	8,473	3,134	11,607	18,010	631	18,641	(7,034)
2068	8,549	3,178	11,727	18,374	639	19,013	(7,286)
2069	8,624	3,223	11,847	18,738	648	19,385	(7,539)
2070	8,699	3,268	11,967	19,101	656	19,758	(7,790)

Table 7-6. Participating Utilities' (50,000 – 99,999) Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	4,168	3,469	7,637	1,289	122	1,411	6,226
2016	3,986	3,539	7,525	1,611	153	1,763	5,761
2017	4,210	3,609	7,819	1,611	183	1,794	6,025
2018	4,260	3,679	7,939	1,933	214	2,147	5,793
2019	4,311	3,750	8,061	2,255	244	2,499	5,562
2020	4,364	3,820	8,184	2,899	275	3,174	5,010
2021	4,419	3,881	8,300	3,413	289	3,702	4,598
2022	4,479	3,942	8,421	3,927	304	4,231	4,190
2023	4,539	4,002	8,541	4,441	318	4,759	3,782
2024	4,597	4,063	8,660	4,955	332	5,287	3,373
2025	4,656	4,123	8,779	5,469	347	5,816	2,963
2026	4,715	4,184	8,898	5,983	361	6,344	2,554
2027	4,776	4,244	9,020	6,497	376	6,872	2,148
2028	4,836	4,304	9,141	7,011	390	7,401	1,740
2029	4,897	4,365	9,261	7,524	405	7,929	1,332
2030	4,957	4,425	9,382	8,038	419	8,457	925
2031	5,014	4,487	9,501	8,561	415	8,976	525
2032	5,072	4,549	9,621	9,083	411	9,494	127
2033	5,130	4,611	9,741	9,605	407	10,013	(271)
2034	5,189	4,673	9,861	10,127	404	10,531	(669)
2035	5,247	4,735	9,982	10,650	400	11,049	(1,068)
2036	5,305	4,797	10,102	11,172	396	11,568	(1,466)
2037	5,363	4,859	10,222	11,694	392	12,086	(1,864)
2038	5,421	4,921	10,342	12,216	388	12,604	(2,262)
2039	5,480	4,983	10,462	12,739	384	13,123	(2,661)
2040	5,538	5,045	10,583	13,261	380	13,641	(3,059)
2041	5,601	5,105	10,706	13,795	384	14,179	(3,474)
2042	5,664	5,165	10,829	14,329	388	14,717	(3,888)
2043	5,726	5,225	10,951	14,863	392	15,255	(4,304)
2044	5,788	5,285	11,074	15,397	396	15,792	(4,719)
2045	5,851	5,345	11,197	15,931	399	16,330	(5,133)
2046	5,914	5,405	11,320	16,465	403	16,868	(5,548)
2047	5,977	5,465	11,443	16,999	407	17,406	(5,963)
2048	6,040	5,526	11,566	17,532	411	17,943	(6,378)
2049	6,103	5,586	11,689	18,066	415	18,481	(6,792)
2050	6,166	5,646	11,812	18,600	418	19,019	(7,207)
2051	6,223	5,694	11,917	19,134	420	19,554	(7,637)
2052	6,281	5,742	12,023	19,667	422	20,089	(8,066)
2053	6,338	5,791	12,128	20,200	424	20,624	(8,496)
2054	6,394	5,839	12,233	20,733	426	21,159	(8,926)
2055	6,451	5,887	12,339	21,267	428	21,694	(9,356)
2056	6,509	5,935	12,444	21,800	430	22,229	(9,785)
2057	6,566	5,984	12,550	22,333	431	22,764	(10,215)
2058	6,623	6,032	12,655	22,866	433	23,300	(10,644)
2059	6,681	6,080	12,761	23,399	435	23,835	(11,074)
2060	6,738	6,129	12,867	23,933	437	24,370	(11,503)
2061	6,799	6,175	12,974	24,426	439	24,865	(11,891)
2062	6,859	6,222	13,081	24,920	441	25,361	(12,280)
2063	6,920	6,268	13,188	25,413	443	25,856	(12,668)
2064	6,981	6,315	13,295	25,907	445	26,352	(13,056)
2065	7,041	6,361	13,402	26,400	447	26,847	(13,444)
2066	7,103	6,408	13,511	26,893	449	27,342	(13,832)
2067	7,163	6,454	13,618	27,387	451	27,838	(14,220)
2068	7,224	6,501	13,725	27,880	453	28,333	(14,608)
2069	7,285	6,547	13,832	28,374	455	28,829	(14,996)
2070	7,345	6,594	13,939	28,867	457	29,324	(15,385)

Table 7-7. Participating Utilities' (Over 100,000) Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	44,928	10,502	55,430	12,463	4,288	16,751	38,679
2016	58,057	11,672	69,729	15,579	5,360	20,939	48,791
2017	61,515	11,825	73,340	15,579	6,432	22,010	51,330
2018	61,547	11,979	73,525	18,694	7,504	26,198	47,327
2019	61,917	12,088	74,006	21,810	8,576	30,386	43,620
2020	62,406	12,198	74,604	28,042	9,648	37,689	36,915
2021	62,855	12,353	75,208	29,513	9,948	39,461	35,747
2022	63,415	12,509	75,923	30,984	10,249	41,233	34,690
2023	63,846	12,664	76,510	32,455	10,550	43,005	33,505
2024	64,275	12,844	77,118	33,926	10,851	44,777	32,341
2025	64,714	13,023	77,738	35,397	11,152	46,549	31,189
2026	64,384	13,197	77,582	36,868	11,453	48,321	29,261
2027	64,419	13,377	77,796	38,339	11,754	50,093	27,704
2028	64,609	13,557	78,166	39,810	12,055	51,864	26,301
2029	64,798	13,736	78,535	41,281	12,355	53,636	24,898
2030	64,988	13,916	78,905	42,752	12,656	55,408	23,496
2031	65,687	14,050	79,737	44,182	12,430	56,611	23,126
2032	66,386	14,184	80,570	45,611	12,203	57,814	22,756
2033	67,084	14,319	81,403	47,041	11,976	59,017	22,386
2034	67,781	14,452	82,234	48,470	11,749	60,220	22,014
2035	68,469	14,586	83,056	49,900	11,523	61,423	21,633
2036	69,016	14,720	83,736	51,330	11,296	62,625	21,111
2037	69,713	14,854	84,566	52,759	11,069	63,828	20,738
2038	70,418	14,988	85,405	54,189	10,842	65,031	20,374
2039	71,123	15,121	86,245	55,619	10,615	66,234	20,011
2040	71,829	15,255	87,084	57,048	10,389	67,437	19,647
2041	72,388	15,333	87,720	58,554	10,553	69,107	18,614
2042	72,945	15,411	88,355	60,060	10,716	70,777	17,579
2043	73,504	15,488	88,992	61,566	10,880	72,446	16,546
2044	74,061	15,567	89,628	63,072	11,044	74,116	15,511
2045	74,618	15,645	90,263	64,578	11,208	75,786	14,477
2046	75,188	15,723	90,911	66,084	11,371	77,456	13,455
2047	75,758	15,802	91,560	67,590	11,535	79,126	12,434
2048	76,330	15,880	92,210	69,096	11,699	80,795	11,414
2049	76,899	15,959	92,857	70,602	11,863	82,465	10,392
2050	77,469	16,037	93,506	72,108	12,027	84,135	9,371
2051	77,936	16,171	94,107	73,895	12,005	85,900	8,207
2052	78,402	16,304	94,707	75,682	11,983	87,665	7,042
2053	78,869	16,438	95,307	77,469	11,961	89,429	5,877
2054	79,335	16,574	95,909	79,255	11,939	91,194	4,715
2055	79,802	16,711	96,513	81,042	11,917	92,959	3,554
2056	80,268	16,847	97,115	82,829	11,895	94,724	2,391
2057	80,733	16,984	97,717	84,616	11,873	96,488	1,228
2058	81,200	17,120	98,320	86,403	11,851	98,253	67
2059	81,666	17,257	98,923	88,189	11,829	100,018	(1,095)
2060	82,133	17,393	99,526	89,976	11,807	101,783	(2,257)
2061	82,577	17,526	100,103	91,546	11,757	103,303	(3,200)
2062	83,020	17,660	100,680	93,116	11,708	104,823	(4,144)
2063	83,464	17,793	101,257	94,686	11,658	106,344	(5,087)
2064	83,907	17,929	101,836	96,255	11,609	107,864	(6,028)
2065	84,352	18,065	102,416	97,825	11,559	109,384	(6,968)
2066	84,796	18,201	102,997	99,395	11,510	110,905	(7,908)
2067	85,240	18,337	103,577	100,965	11,460	112,425	(8,848)
2068	85,683	18,473	104,156	102,535	11,411	113,945	(9,790)
2069	86,127	18,609	104,736	104,104	11,361	115,466	(10,730)
2070	86,572	18,745	105,317	105,674	11,312	116,986	(11,669)

7.1 Participating Utilities' Progress in Meeting Five-year Water Conservation Plan Goals

Another task of this project required an assessment of whether participating individual utilities were meeting their five-year water conservation plan goals.

These plans are required by the TWDB to contain 5- and 10-year goals for total GPCD and water loss GPCD. [29]

Each individual report completed for this project includes in-depth analysis on whether these goals are being attained.

Table 7-8 shows how many participating utilities by region were meeting their water conservation plan goals for the year 2016, as well as if 5- and 10-year marks are being achieved. For nearly all utilities, the five-year goal is set for 2019, and the 10-year goal is set for 2024, because their most recent five-year conservation plan was drafted in 2014. Occasionally, these goals are sooner or further out based on when the last plan was submitted.

Table 7-8. Individual Utility Goals Achievement by Region.

Region	Total Participating Utilities in Region	Quantified Savings Only Meeting GPCD Goals			Most Current (2015) Water Loss GPCD Meeting Water Loss GPCD Goals			Most Current Total GPCD Meeting Total GPCD Goals		
		2016	5-year	10-year	2016	5-year	10-year	2016	5-year	10-year
A	6	2	2	2	4	4	4	6	4	3
B	1	1	1	1	1	1	1	1	1	1
C	63	47	39	35	37	35	33	49	46	42
D	1	1	1	1	1	1	1	0	0	0
E	2	1	1	1	0	0	0	0	0	0
F	10	5	4	3	6	6	5	9	9	9
G	21	14	11	7	13	10	9	19	18	16
H	21	16	10	8	15	12	12	16	11	11
J	2	1	1	1	1	1	1	0	0	0
K	8	6	6	5	5	5	4	5	4	4
L	11	5	5	4	4	3	3	10	7	7
M	15	12	8	8	10	8	4	11	9	6
N	2	2	2	2	2	1	1	1	1	1
O	6	4	3	3	4	1	1	5	5	5
P	1	0	0	0	1	1	1	1	0	0
TEXAS	170	117	94	81	104	89	80	133	115	105

[29] The plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

8 Activity Findings

As one might imagine, surveying utilities with service area populations as small as 1,000 people and as large as 2.25 million people yielded quite the diversity of conservation activities being implemented. Many utilities perform no conservation activities outside of reducing water loss, while others vigorously pursue more than 35 unique measures.

By presenting activities with the highest incidence among participating utilities and showing the savings they each yield statewide, water planners should be able to glean which ones are most effective.

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values within the graph show how much these activities are saving statewide. In each regional report completed for this project, these same 12 activity categories and their savings are broken down for participating water planning regions.

For specific formulas used to quantify these activities, refer to Section 6.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[30] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

[30] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators, toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet per year).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	48,047	26,886	91,644	11,420	5,717	573	1,188	720	117	106	7,504	20,233	214,408
2016	51,928	54,929	103,146	11,604	5,752	477	1,188	1,230	114	108	7,845	22,056	260,590
2017	52,631	64,686	107,992	11,788	7,145	328	964	1,230	106	74	7,846	18,425	273,381
2018	53,334	65,244	109,402	11,973	7,187	135	720	1,230	98	45	7,847	17,114	274,444
2019	53,902	65,804	110,812	12,157	7,228	68	460	1,230	89	23	7,845	16,722	276,408
2020	54,473	66,358	112,223	12,342	7,270	24	228	1,230	86	7	7,872	16,616	278,747
2021	55,206	66,919	113,662	12,526	7,312	1		1,230	77		7,910	16,348	281,206
2022	55,939	67,476	115,101	12,711	7,353			1,230	65		7,828	16,327	284,042
2023	56,672	68,034	116,540	12,898	7,395			1,230	52		7,783	15,862	286,475
2024	57,472	68,588	117,979	13,083	7,437			1,230	30		7,758	15,390	288,967
2025	58,272	69,145	119,418	13,267	7,478			1,230	8		7,741	14,931	291,497
2026	59,056	69,709	120,857	13,452	7,520			1,230	1		7,741	12,084	291,650
2027	59,857	70,266	122,296	13,636	7,562			1,230			7,741	10,356	292,948
2028	60,657	70,826	123,735	13,821	7,603			1,230			7,741	9,100	294,714
2029	61,457	71,381	125,174	14,005	7,645			1,230			7,741	7,844	296,481
2030	62,258	71,941	126,613	14,190	7,687			1,230			7,741	6,588	298,248
2031	62,910	72,543	128,285	14,397	7,724			1,230			7,741	6,567	301,402
2032	63,564	73,160	129,957	14,604	7,760			1,230			7,741	6,545	304,558
2033	64,217	73,762	131,628	14,811	7,797			1,230			7,741	6,524	307,711
2034	64,875	74,363	133,300	15,016	7,834			1,230			7,741	6,502	310,868
2035	65,534	74,977	134,972	15,223	7,871			1,230			7,741	6,443	313,992
2036	66,193	75,585	136,644	15,430	7,908			1,230			7,741	5,956	316,689
2037	66,852	76,189	138,316	15,637	7,945			1,230			7,741	5,929	319,842
2038	67,511	76,797	139,988	15,841	7,982			1,230			7,741	5,929	323,020
2039	68,169	77,404	141,660	16,049	8,019			1,230			7,741	5,930	326,204
2040	68,828	78,009	143,332	16,256	8,056			1,230			7,741	5,930	329,382
2041	69,319	78,603	144,631	16,425	8,097			1,230			7,741	5,937	331,983
2042	69,811	79,187	145,929	16,592	8,137			1,230			7,741	5,944	334,573
2043	70,303	79,772	147,228	16,761	8,178			1,230			7,741	5,952	337,168
2044	70,802	80,353	148,527	16,931	8,218			1,230			7,741	5,959	339,762
2045	71,302	80,941	149,826	17,101	8,259			1,230			7,741	5,961	342,363
2046	71,801	81,529	151,125	17,267	8,299			1,230			7,741	6,006	344,998
2047	72,301	82,116	152,423	17,437	8,340			1,230			7,741	6,051	347,639
2048	72,800	82,704	153,722	17,606	8,380			1,230			7,741	6,096	350,280
2049	73,300	83,288	155,021	17,776	8,421			1,230			7,741	6,141	352,918
2050	73,799	83,876	156,320	17,942	8,461			1,230			7,741	6,186	355,555
2051	74,427	84,441	157,379	18,105	8,504			1,230			7,741	6,217	358,047
2052	75,056	85,007	158,438	18,267	8,547			1,230			7,741	6,248	360,539
2053	75,685	85,575	159,497	18,426	8,589			1,230			7,741	6,279	363,028
2054	76,323	86,144	160,556	18,589	8,632			1,230			7,741	6,310	365,526
2055	76,960	86,715	161,615	18,748	8,674			1,230			7,741	6,341	368,027
2056	77,598	87,278	162,674	18,911	8,717			1,230			7,741	6,372	370,522
2057	78,236	87,843	163,733	19,070	8,759			1,230			7,741	6,403	373,017
2058	78,874	88,415	164,792	19,232	8,802			1,230			7,741	6,434	375,521
2059	79,512	88,986	165,851	19,392	8,844			1,230			7,741	6,465	378,023
2060	80,149	89,551	166,910	19,554	8,887			1,230			7,741	6,496	380,523
2061	80,823	90,092	167,918	19,737	8,932			1,230			7,741	6,530	383,007
2062	81,496	90,633	168,925	19,919	8,977			1,230			7,741	6,564	385,488
2063	82,170	91,174	169,933	20,102	9,022			1,230			7,741	6,598	387,969
2064	82,855	91,715	170,941	20,284	9,067			1,230			7,741	6,632	390,464
2065	83,540	92,249	171,949	20,470	9,112			1,230			7,741	6,666	392,960
2066	84,225	92,793	172,957	20,652	9,157			1,230			7,741	6,700	395,458
2067	84,910	93,337	173,965	20,835	9,202			1,230			7,741	6,734	397,954
2068	85,595	93,878	174,972	21,017	9,247			1,230			7,741	6,768	400,449
2069	86,280	94,419	175,980	21,200	9,292			1,230			7,741	6,802	402,945
2070	86,969	94,956	176,988	21,385	9,337			1,230			7,741	6,836	405,446

Table 8-2 displays the number of utilities performing each of these 12 activity categories. In addition, it also isolates four utility population strata—Under 10,000; 10,000 to 49,000; 50,000 to 99,000; and over 100,000—to show how many of each size classification implements each activity, as well as the average number of activities performed.

Table 8-2. Number of Utilities Implementing Most Widely Used Conservation Activities by Population Strata.

2020 Population of Participating Utilities	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
Total Under 10K	37	26	5	3	0	3	2	1	1	0	1	1	80	2.2
Total 10K-49K	73	39	19	6	0	2	9	4	0	2	7	3	164	2.2
Total 50-99K	24	17	6	2	3	7	3	3	9	2	7	6	89	3.7
Total Over 100K	36	33	16	4	3	5	8	11	8	5	9	76	214	5.9
TEXAS	170	115	46	15	6	17	22	19	18	9	24	86	547	3.2

Table 8-3 shows how many utilities in each region implement these most widely used activities.

Table 8-3. Number of Utilities Implementing Most Widely Used Conservation Activities by Region.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits (SF)	Vendor Take-home Device Kits	Vendor Retrofit Program	Rain Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
A	6	5	0	0	0	0	0	1	1	0	1	0	14	2.3
B	1	1	1	0	1	0	0	0	0	0	0	0	4	4.0
C	63	49	31	3	3	6	3	14	3	5	6	27	213	3.4
D	1	0	0	1	0	0	0	0	0	0	0	0	2	2.0
E	2	0	2	0	0	0	0	0	0	0	1	3	8	4.0
F	10	7	1	0	0	0	0	0	0	0	0	0	18	1.8
G	21	13	2	2	1	4	1	1	5	1	4	3	58	2.8
H	21	10	2	4	1	1	15	3	3	3	2	1	66	3.1
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
J	2	1	0	0	0	0	0	0	0	0	0	0	3	1.5
K	8	5	6	2	0	4	1	0	3	0	4	24	57	7.1
L	11	7	0	0	0	2	1	0	2	0	5	27	55	5.0
M	15	9	0	1	0	0	1	0	0	0	1	0	27	1.8
N	2	1	0	0	0	0	0	0	1	0	0	0	4	2.0
O	6	6	1	2	0	0	0	0	0	0	0	1	16	2.7
P	1	1	0	0	0	0	0	0	0	0	0	0	2	2.0
TEXAS	**170**	**115**	**46**	**15**	**6**	**17**	**22**	**19**	**18**	**9**	**24**	**86**	**547**	**3.2**

8.1 Ordinances Permanently Limiting Outdoor Watering to Twice Per Week (or less)

Twice-per-week outdoor watering ordinances save the most water of any commonly performed activity. Project data show that since 2011, 46 of the 170 participating utilities statewide have adopted the measure with 31 of those utilities located in Region C. With only 45 utilities pursuing this activity, it is estimated that this activity will be saving 112,223 acre-feet of water annually by 2020. By comparison, water loss reduction, which is an activity undertaken by all 170 participating utilities in the study, is projected to yield 54,473 acre-feet annually in 2020.

This activity has the added benefits of growing in savings as utility demand grows, permanency, and no direct cost to the customer. In fact, when using less water outdoors, customers will save money over time.

9 Observations on BMPs

In 2013, the TWDB released its "Water Conservation Best Management Practices: Best Management Practices for Municipal Water Users Guide" (Texas Water Development Board, 2013). The report was an update from a study originally compiled in 2004 and identifies 26 BMPs for municipal water users to consider, seven of which were updated from the 2004 report. One of the sections of the report offers guidance on how to quantify savings from these BMPs.

- The BMPs are considered a useful reference for utilities motivated to conserve. They have been vetted and revised by stakeholder groups such as the Water Conservation Advisory Council.

- Awareness of the Texas Water Development Board's BMPs is high.

- Utility staff, consultants, and regional planners refer to BMPs throughout their reports.

- Current TWDB reporting requirements includes a census of BMPs employed and estimated savings.

- As a tool for guidance they generally take a “top-down” approach when estimating savings, i.e. comparing consumption after the implementation of the activity to the water usage before the implementation of the BMP.

- Of the 26 BMPs, 14 of them roughly correlated to the measurable activities identified in this report. Of those 14, seven were similar to the PCS activities in this report. They had to do with toilets, aerators, and showerheads. Outdoor audits and surveys were four more that aligned generally with activities in this report. Conservation pricing, rain barrels, and water waste ordinances could also be aligned with this report.

- A census of which BMPs are being employed by individual utilities is required in the annual conservation reports. However, it was noted that there was some confusion on how the census was to be filled out.

- Some of the BMPs are rather broad in scope and sometimes instructions do not cover all possible interpretations. For example, BMP 7.4 calls for replacement of old shower heads, aerators, and toilet flappers. So when asked, a utility staff can answer “yes” to the question of implementation of this BMP even if their effort is to give away aerators and rain gauges at a local annual festival. They could also count this activity in 6.1 Public Information.

- There were several instances in the regional reports where the report authors lamented about the difficulty of estimating savings for BMPs. Many regional reports called for more data and guidance. Several of the recommended methods of quantifying savings require significant time and record keeping. They may not be practical for the overwhelming number of WUGs.

- If a “bottom-up” approach to measuring and quantifying water conservation is adopted, the Water Conservation Advisory Council should assist in aligning BMPs with specific conservation activities. A “bottom-up” approach allows for more granular analysis of specific activities, and the BMPs and specific activities should eventually align.

To summarize, the TWDB’s BMPs are highly regarded, well thought through methods of conserving water. And yet, for the purpose of measuring results, they are not well suited. With the help of stakeholders and a better, easier way to analyze data, the process of measuring the results of implementing BMPs could improve. Stakeholder involvement would be important in the development of a “bottom-up” approach to enhance the quantification of savings.

10 Recommendations

The following recommendations are focused on answering the question:

How can the state continue to meet the conservation supply volumes outlined in the State Water Plan?

1. **The RWPGs can play a vital role to educate, but should not be expected to drive conservation efforts.**

While the RWPGs obviously play a vital role in planning and ensuring that Texas' future overall water needs are met, ensuring that conservation supply volumes are met is not a role they are particularly well suited for. The composition, frequency of official meetings, and other functions they assume make it difficult for these entities to really increase implementation of conservation measures.

However, simply communicating the existence of recommended conservation supply volumes to the WUGs in their group could still be valuable.

2. **Wholesale water providers (WWPs) should function as key stakeholders and drivers of monitoring, measuring, and reporting conservation activity to their customer cities and utilities.**

WWPs are uniquely positioned to encourage conservation and achieve actionable results. These entities set water purchase rates and form water delivery contracts—two instances that provide opportunities to introduce conservation incentives. They have a direct interest in conserving as their water systems are expected to shoulder the burden of rapidly increasing populations and water demand. WWPs can also carry out district or system-wide conservation initiatives that can be adopted by cities with lesser resources.

The TWDB's Water Conservation Advisory Council recently adopted BMP that outlines this purpose and forward-thinking WWPs, such as Dallas Water Utilities, Lower Colorado River Authority, North Texas Municipal Water District, Tarrant Regional Water District, Upper Trinity Regional Water District, and others are already advancing this concept.

Here are several ways mentioned that WWPs can assist their customers with conservation:

- WWP conduct yearly water conservation plan implementation surveys to monitor progress of individual customer plan implementation and to *quantify* water savings from implementation of customer programs where possible.
- Develop a tracking system to track technical assistance and outreach activities
- Development of model water conservation plans and drought contingency plans that could be adopted by WWP customers
- Assistance to customers developing their own water conservation plans and drought contingency plans.

- Researching and providing advice on how to implement specific conservation programs or measures (Texas Water Development Board, 2013a)

3. **Consider using a stakeholder group to form a consensus on savings estimates for activities being implemented throughout Texas**

For many activities surveyed during this project, there are numerous credible studies that have been performed to determine reliable savings estimates. There are also similar techniques used to quantify savings for many of them. However, it would be useful and lend credibility to any future projects similar to this one, if stakeholders specific to the Texas water community could agree upon the most reliable estimates for as many activities as possible being performed throughout the state. As it stands, much of this information is only available from many different sources. A stakeholder group could centralize the effort and serve as a repository for agreed-upon savings estimates.

Quantifying water conservation is a process with inherent variables across regions and from utility to utility, but it is possible using the wealth of resources already available in the field to develop Texas-specific estimates for most activities being implemented in the state. Having those estimates would allow the work performed for this project to be repeated with more confidence, buy-in from interested entities, and widely accepted results.

4. **Utilities should consider the suggested activities listed in each of the individual reports issued as part of this project.**

Up to four activities were chosen as potential suggested activities in individual reports. These activities are: AMI systems with customer engagement portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings

Suggested strategies were chosen with the purpose of saving enough water to cover any shortages that a WUG may be facing in meeting its municipal conservation goals as recommended in their regional plan. Suggestions were also made to utilities that are meeting their goals, but may want to do more. The following is a description of the recommended strategies and why they were chosen. Also included is a brief explanation of why some other strategies—while effective—were not recommended.

AMI System with Customer Engagement Portal

This activity was included because of the potential AMI offers statewide. Interviews conducted around the state revealed that many utilities, from the smallest to the largest are considering some level of implementation of AMI. Of the 170 participating utilities, 89 already have some form of automated system. It is popular because it is effective in helping utility staff and their customers to have a better understanding of water usage. It helps detect leaks and saves administrative expenses, and as technology continues to improve, the feasibility of AMI can perform more functions and provide more data.

AMI is the most expensive recommendation, but can be eligible for favorable financing from the TWDB. Favorable financing and administrative savings makes AMI an achievable activity.

In addition, customer portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data.

Twice-per-week (or less) Outdoor Watering Ordinances

A twice-per-week (or less) watering ordinance is the most effective activity in terms of saving water. The impact of these ordinances can easily be seen in Region C. Within Region C, of the 63 participating utilities, 31 have implemented a twice-per-week outdoor watering ordinance. With ordinances in place, participating utilities are estimated to exceed their collective supply volumes by 64,277 acre-feet per year in 2020. Without such ordinances, those utilities are estimated to exceed their volumes by only 6,717 acre-feet per year in 2020. The ordinances are having a major impact on saving water. It also shows that the concept of twice-per-week is gaining momentum, and that the activity is achievable and returns outstanding water savings.

This recommendation has best results where there is a proliferation of outdoor watering systems, such as larger cities and suburbs. However, any community can benefit by some degree of managing outdoor use.

There is no immediate cost to implementing an ordinance, however, this activity will have an immediate impact on revenues and should be planned for in the budget process.

Outstanding results, ease of implementation, and growing acceptance makes twice-per-week ordinances an activity that should be given serious consideration.

Water Rate Increases

Conservation pricing and water rate increases can be used to effectively target high-volume customers, while also maintaining revenue requirements. The project recommended this activity to illustrate savings that could contribute to meeting supply volumes with low cost to the utility.

Determining the right balance and consideration to customers is an exercise unique to each individual utility. By providing savings estimates associated with this measure, utility staff can consider this benefit along with other factors that may make raising water rates the right decision.

Rain Barrels

Rain barrels are growing in popularity. They produce the lowest water savings of the four recommended activities, but they are a great first step in establishing a proactive conservation program.

The public easily understands the purpose of a rain barrel, making it an easily adopted measure for customers while also offering an opportunity to engender positive customer relations through sales, rebates, and give-away events. Vendors are plentiful and there are many ways to promote their use.

Activities Not Recommended

There are many other effective activities going on around the state that were not specifically recommend for various reasons. For example, activities that contribute to plumbing code savings are well known and quantifiable. However, these savings are going to be realized over time without any specific action by the utilities. Recommendations were made to enhance the suite of activities being employed by the utilities.

Outdoor water audits and budgets are another useful tool in a conservation program that can yield results. However, this activity requires time, money, and expertise. Most utilities do not have the ability to provide all the necessary resources for this activity. The goal of this project's recommendations was to provide suggestions that would actually be considered and eventually implemented.

The methodology and formulas provided with this report could allow utilities to explore hypothetical scenarios. Various options could be studied based on many factors including estimates of savings potential. However, that, too, is a complicated process not likely to be widely pursued.

Section 11 describes a practical way to quantify conservation activities using an easy-to-understand web-based dashboard that will make savings estimates a process that any utility could benefit from. Such a system will make it easier for utilities to design a custom-made conservation program suited to their own specifics needs and limitations.

11 Practical Method to Estimate and Measure the Implementation of Recommended Municipal Water Conservation Activities in the State Water Plan

The method used to execute this project proved to be thorough, highly detailed at the utility level, and malleable to changes along the way. However, it also proved to be time consuming for project staff and required much of participating utility's staff.

TWDB's 2012 quantification report recommended three ways that similar work could be accomplished (BBC Research and Consulting, 2012).

1. Develop consistent regional and statewide conservation savings estimates;
2. Develop a potential tool to standardize and improve provider-level water use data and conservation savings estimates; and
3. Develop a common data collection and reporting system that would create a robust database of water conservation data.

The findings of this report concur with those recommendations, but with modern updates to what can now be achieved. It is recommended that the TWDB adopt a dynamic, easy-to-use web application that streamlines these processes and:

- Combines bottom-up approaches to quantification conducted by some of the largest utilities with the top-down approaches used by states
- Makes data collection more accurate every year and eventually real-time
- Makes the water conservation state planning function based on yearly projections and able to be updated based on real savings being achieved in the field
- Instills higher confidence in conservation volumes that are being achieved every year instead of more uncertain decadal volumes being formulated every five years
- Allows the quantification process to be performed for utilities that would not be able to otherwise due to limited staff time and resources
- Because of ease of use, allows many more utilities to participate in the quantification process every year to gain a fuller picture of conservation being achieved
- Provides utilities with clear, easy-to-understand visual results related to goal achievement and tracking progress

12 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org
http://www.savetexaswater.org/bmp/

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

13 References

A&N Technical Services, Inc. 2005. BMP Costs & Savings Study: A Guide to the Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. Prepared for California Urban Water Conservation Council. Section 2.

Austin Water. 2016. Austin Water Conservation Digests. Developed by Austin Water staff.

AWWA Research Foundation. 1999. Residential End Water Uses.

BBC Research and Consulting. 2012. Water Conservation Savings Quantification Study. Prepared for Texas Water Development Board.

California Urban Water Conservation Council. 2004. A Report on Potential Best Management Practices. Prepared for the California Urban Water Conservation Council by Koeller and Company.

Chesnutt, T.W. and D. Mitchell. 2013. Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Reports. Prepared for California Water Foundation and East Bay Muncipal Utility District.

City of Dallas Water Utilities. 2016. City of Dallas: Water Conservation Five-year Work Plan. Developed by Dallas Water Utilities staff.

East Bay Municipal Utility District. 2014. Presentation to Finance Administration Committee: Advanced Metering Infrastructure Pilot Studies Update.

El Paso Water. April 13, 2017. Presentation to Texas Water Development Board: Conservation Program.

Frontier Associates. 2015. WaterWise Evaluation for Resource Action Programs. WaterWise Report.

GDS Associates, Inc. 2002. Quantifying the Effectiveness of Various Water Conservation Techniques in Texas. Prepared for Texas Water Development Board.

Goedrich, Kurt. 2016. Save Water Co. Texas Data.

Hermitte, S.M. and R. Mace. 2012. The Grass is Always Greener… Outdoor Residential Water Use in Texas. Texas Water Development Board Technical Note 12-01.

IBM Research. 2011. Smart Water Pilot Study Report. Water Savings Results.

San Antonio Water System. 2016. Conservation Program Summaries: 2010 – 2015. Developed by San Antonio Water System staff.

SBW Consulting, Inc. 2007. Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-rinse Spray Valve Installation Program (Phase 2). Submitted to California Public Utilities Commission.

Sierra Club-Lone Star Chapter and National Wildlife Federation. 2015. Water Conservation by the Yard: Estimating Savings from Outdoor Watering Restrictions. Texas Living Waters Project.

Texas Water Development Board. 2012. Guidance and Methodology for Reporting on Water Conservation and Water Use. Developed by Texas Water Development Board and Texas Commission on Environmental Quality in consultation with Water Conservation Advisory Council.

Texas Water Development Board. Revised 2013. Water Conservation Best Management Practices: Best Management Practices for Municipal Water Users. TWDB Report 362.

Texas Water Development Board. Revised 2013a. Water Conservation Best Management Practices: Best Management Practices for Wholesale Water Providers. TWDB Report 362.

Texas Water Development Board. 2016. 2016 Panhandle Water Plan. Prepared for Panhandle Water Planning Group.

Texas Water Development Board. 2016a. 2016 Region B Regional Water Plan. Prepared for Region B Water Planning Group.

Texas Water Development Board. 2016b. 2016 Region C Water Plan. Prepared for Region C Water Planning Group.

Texas Water Development Board. 2016c. 2016 Region D Regional Water Plan. Prepared for The North East Texas Regional Water Planning Group.

Texas Water Development Board. 2016d. 2016 Far West Texas Water Plan. Prepared by Far West Texas Water Planning Group.

Texas Water Development Board. 2016e. 2016 Region F Water Plan. Prepared for Region F Water Planning Group.

Texas Water Development Board. 2016f. 2016 Brazos G Regional Water Plan. Prepared for Brazos G Water Planning Group.

Texas Water Development Board. 2016g. 2016 Regional Water Plan. Prepared by Region H Water Planning Group.

Texas Water Development Board. 2016h. 2016 Plateau Region Water Plan. Prepared by Plateau Region Water Planning Group.

Texas Water Development Board. 2016i. 2016 Region K Water Plan. Prepared by Lower Colorado Regional Water Planning Group.

Texas Water Development Board. 2016j. 2016 South Central Texas Regional Water Plan. Prepared by South Central Texas Regional Water Planning Group.

Texas Water Development Board. 2016k. 2016 Rio Grande Regional Water Plan. Prepared by Rio Grande Regional Water Planning Group.

Texas Water Development Board. 2016l. 2016 Coastal Bend Regional Water Plan. Prepared by Coastal Bend Regional Water Planning Group.

Texas Water Development Board. 2016m. 2016 Llano Estacado Regional Water Plan. Prepared by Llano Estacado Regional Water Planning Group.

Texas Water Development Board. 2016n. 2016 Lavaca Regional Water Plan. Prepared by Lavaca Regional Water Planning Group.

Texas Water Development Board. 2016o. Water Conservation Plan Annual Report ~ Retail Water Supplier. TWDB Form No. 1966.

Texas Water Development Board. 2017. Water for Texas: 2017 State Water Plan. Accessed June 20, 2017. http://www.twdb.texas.gov/waterplanning/swp/2017/doc/SWP17-Water-for-Texas.pdf.

Texas A&M AgriLife Research Extension and Texas Water Resources Institute. 2016. Presentation: Continued Development, Research, and Commercialization of a Web-based Portal Using AMI Data.

The High Efficiency Laundry Metering & Marketing Analysis. 1997. THELMA Impact Analysis for EPRI Retail Market Tools and Services. Prepared by SBW Consulting, National Center for Appropriate Technology, et al.

United States Environmental Protection Agency. 1998. WaterSense: Water Conservation Plan Guidelines. Appendix B.

United States Environmental Protection Agency. 2017. WaterSense: Water Budget Tool. Downloaded January 20, 2017. https://www.epa.gov/watersense/water-budget-tool.

Westin Engineering, Inc. 2015. AMI Business Case. Prepared for City of Santa Barbara.

Whitcomb, J. 1999. Water Price Elasticities for Single-family Homes in Texas. Prepared for Texas Water Development Board.

Whitcomb, J.B. 2000. Residential Water Survey Evaluation. Prepared for Contra Costa Water District.

Intentionally Left Blank

Appendix A – Participating Utilities' Total Estimated Savings Compared to Participants' Water Management Strategies Supply Volumes

Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year) by Region

Terms used in Tables A1–A15:

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[1] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[1] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table A-1. **Region A Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).**

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	761	1,287	2,047	1,005	0	1,005	1,042
2016	1,111	1,300	2,410	1,256	0	1,256	1,154
2017	1,151	1,313	2,464	1,256	0	1,256	1,207
2018	1,163	1,326	2,489	1,508	0	1,508	981
2019	1,175	1,340	2,515	1,759	0	1,759	755
2020	1,187	1,353	2,540	2,262	0	2,262	278
2021	1,199	1,369	2,568	2,287	0	2,287	281
2022	1,211	1,386	2,596	2,312	0	2,312	284
2023	1,223	1,402	2,625	2,337	0	2,337	288
2024	1,235	1,418	2,653	2,362	0	2,362	291
2025	1,247	1,434	2,681	2,387	0	2,387	294
2026	1,258	1,450	2,709	2,413	0	2,413	296
2027	1,271	1,466	2,737	2,438	0	2,438	299
2028	1,283	1,483	2,765	2,463	0	2,463	302
2029	1,295	1,499	2,793	2,488	0	2,488	305
2030	1,307	1,515	2,822	2,512	0	2,512	309
2031	1,320	1,531	2,852	2,537	0	2,537	315
2032	1,333	1,548	2,881	2,560	0	2,560	321
2033	1,347	1,564	2,911	2,583	0	2,583	328
2034	1,360	1,581	2,941	2,607	0	2,607	334
2035	1,373	1,597	2,970	2,630	0	2,630	340
2036	1,386	1,613	3,000	2,653	0	2,653	347
2037	1,400	1,630	3,029	2,677	0	2,677	353
2038	1,413	1,646	3,059	2,700	0	2,700	359
2039	1,426	1,663	3,089	2,723	0	2,723	365
2040	1,439	1,679	3,118	2,744	0	2,744	371
2041	1,453	1,696	3,149	2,771	0	2,771	378
2042	1,467	1,712	3,180	2,795	0	2,795	385
2043	1,481	1,729	3,210	2,819	0	2,819	391
2044	1,496	1,745	3,241	2,843	0	2,843	398
2045	1,510	1,762	3,272	2,867	0	2,867	404
2046	1,524	1,778	3,302	2,892	0	2,892	411
2047	1,538	1,795	3,333	2,916	0	2,916	417
2048	1,552	1,812	3,364	2,940	0	2,940	424
2049	1,566	1,828	3,394	2,964	0	2,964	430
2050	1,580	1,845	3,425	2,986	0	2,986	437
2051	1,596	1,863	3,459	3,015	0	3,015	444
2052	1,612	1,881	3,493	3,042	0	3,042	451
2053	1,627	1,900	3,527	3,069	0	3,069	458
2054	1,643	1,918	3,561	3,096	0	3,096	465
2055	1,658	1,936	3,595	3,122	0	3,122	472
2056	1,674	1,955	3,628	3,149	0	3,149	479
2057	1,689	1,973	3,662	3,176	0	3,176	486
2058	1,705	1,991	3,696	3,203	0	3,203	493
2059	1,721	2,010	3,730	3,230	0	3,230	500
2060	1,736	2,028	3,764	3,255	0	3,255	507
2061	1,752	2,047	3,800	3,285	0	3,285	515
2062	1,769	2,067	3,835	3,313	0	3,313	523
2063	1,785	2,086	3,871	3,340	0	3,340	531
2064	1,801	2,106	3,907	3,368	0	3,368	538
2065	1,817	2,125	3,942	3,396	0	3,396	546
2066	1,833	2,145	3,978	3,424	0	3,424	554
2067	1,850	2,164	4,014	3,452	0	3,452	562
2068	1,866	2,183	4,049	3,479	0	3,479	570
2069	1,882	2,203	4,085	3,507	0	3,507	578
2070	1,898	2,222	4,120	3,534	0	3,534	585

Table A-2. Region B Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	3,290	1,915	5,205	1,993	0	1,993	3,212
2016	3,292	1,919	5,211	2,491	0	2,491	2,720
2017	3,506	1,922	5,428	2,491	0	2,491	2,937
2018	3,508	1,925	5,434	2,989	0	2,989	2,444
2019	3,511	1,929	5,440	3,488	0	3,488	1,952
2020	3,513	1,932	5,445	4,484	0	4,484	961
2021	3,515	1,939	5,455	4,484	0	4,484	971
2022	3,518	1,946	5,464	4,484	0	4,484	980
2023	3,520	1,953	5,474	4,484	0	4,484	990
2024	3,523	1,961	5,483	4,484	0	4,484	999
2025	3,525	1,968	5,492	4,484	0	4,484	1,008
2026	3,527	1,975	5,502	4,484	0	4,484	1,018
2027	3,530	1,982	5,511	4,484	0	4,484	1,027
2028	3,532	1,989	5,521	4,484	0	4,484	1,037
2029	3,534	1,996	5,530	4,484	0	4,484	1,046
2030	3,537	2,003	5,540	4,484	0	4,484	1,056
2031	3,538	2,008	5,546	4,484	0	4,484	1,062
2032	3,540	2,014	5,553	4,484	0	4,484	1,069
2033	3,541	2,019	5,560	4,484	0	4,484	1,076
2034	3,542	2,025	5,567	4,484	0	4,484	1,083
2035	3,544	2,030	5,574	4,484	0	4,484	1,090
2036	3,545	2,036	5,581	4,484	0	4,484	1,097
2037	3,547	2,041	5,588	4,484	0	4,484	1,104
2038	3,548	2,047	5,595	4,484	0	4,484	1,111
2039	3,549	2,053	5,602	4,484	0	4,484	1,118
2040	3,551	2,058	5,609	4,484	0	4,484	1,125
2041	3,553	2,062	5,615	4,484	0	4,484	1,131
2042	3,555	2,066	5,621	4,484	0	4,484	1,137
2043	3,557	2,070	5,627	4,484	0	4,484	1,143
2044	3,560	2,074	5,633	4,484	0	4,484	1,149
2045	3,562	2,077	5,639	4,484	0	4,484	1,155
2046	3,564	2,081	5,645	4,484	0	4,484	1,161
2047	3,566	2,085	5,651	4,484	0	4,484	1,167
2048	3,568	2,089	5,657	4,484	0	4,484	1,173
2049	3,571	2,093	5,664	4,484	0	4,484	1,180
2050	3,573	2,097	5,670	4,484	0	4,484	1,186
2051	3,578	2,101	5,679	4,484	0	4,484	1,195
2052	3,584	2,104	5,688	4,484	0	4,484	1,204
2053	3,589	2,108	5,697	4,484	0	4,484	1,213
2054	3,595	2,112	5,706	4,484	0	4,484	1,222
2055	3,600	2,115	5,715	4,484	0	4,484	1,231
2056	3,606	2,119	5,725	4,484	0	4,484	1,241
2057	3,611	2,123	5,734	4,484	0	4,484	1,250
2058	3,616	2,126	5,743	4,484	0	4,484	1,259
2059	3,622	2,130	5,752	4,484	0	4,484	1,268
2060	3,627	2,134	5,761	4,484	0	4,484	1,277
2061	3,633	2,137	5,770	4,484	0	4,484	1,286
2062	3,638	2,140	5,778	4,484	0	4,484	1,294
2063	3,643	2,143	5,787	4,484	0	4,484	1,303
2064	3,649	2,146	5,795	4,484	0	4,484	1,311
2065	3,654	2,150	5,804	4,484	0	4,484	1,320
2066	3,659	2,153	5,812	4,484	0	4,484	1,328
2067	3,665	2,156	5,820	4,484	0	4,484	1,336
2068	3,670	2,159	5,829	4,484	0	4,484	1,345
2069	3,675	2,162	5,837	4,484	0	4,484	1,353
2070	3,680	2,165	5,846	4,484	0	4,484	1,362

Table A-3. Region C Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	80,840	18,700	99,540	11,566	10,685	22,252	77,289
2016	95,085	19,101	114,186	14,458	13,357	27,815	86,371
2017	98,150	19,395	117,545	14,458	16,028	30,486	87,058
2018	99,014	19,689	118,703	17,350	18,699	36,049	82,654
2019	99,831	19,984	119,814	20,241	21,371	41,612	78,202
2020	100,781	20,279	121,060	26,024	24,042	50,067	70,994
2021	101,777	20,707	122,484	28,658	24,275	52,933	69,551
2022	102,825	21,135	123,960	31,291	24,508	55,799	68,160
2023	103,534	21,563	125,097	33,925	24,741	58,666	66,431
2024	104,241	21,985	126,226	36,558	24,974	61,532	64,693
2025	104,954	22,407	127,361	39,192	25,207	64,399	62,962
2026	105,672	22,829	128,501	41,825	25,440	67,265	61,236
2027	106,736	23,251	129,987	44,459	25,673	70,132	59,856
2028	107,803	23,673	131,477	47,092	25,906	72,998	58,478
2029	108,867	24,095	132,963	49,725	26,139	75,865	57,098
2030	109,935	24,517	134,452	52,359	26,373	78,732	55,720
2031	111,268	24,812	136,080	54,711	24,915	79,626	56,454
2032	112,607	25,106	137,713	57,063	23,457	80,521	57,193
2033	113,940	25,401	139,341	59,416	22,000	81,415	57,925
2034	115,272	25,699	140,971	61,768	20,542	82,310	58,661
2035	116,608	25,996	142,604	64,120	19,084	83,205	59,400
2036	117,944	26,294	144,238	66,472	17,627	84,099	60,139
2037	119,277	26,591	145,868	68,825	16,169	84,994	60,874
2038	120,613	26,889	147,502	71,177	14,711	85,888	61,613
2039	121,949	27,186	149,135	73,529	13,254	86,783	62,352
2040	123,282	27,484	150,765	75,881	11,796	87,677	63,088
2041	124,291	27,620	151,911	76,931	11,521	88,452	63,459
2042	125,294	27,756	153,050	77,981	11,245	89,226	63,824
2043	126,303	27,892	154,195	79,031	10,970	90,000	64,195
2044	127,306	28,034	155,340	80,080	10,694	90,774	64,565
2045	128,315	28,176	156,491	81,130	10,419	91,549	64,942
2046	129,318	28,317	157,635	82,180	10,143	92,323	65,312
2047	130,324	28,459	158,783	83,230	9,868	93,097	65,686
2048	131,330	28,601	159,931	84,279	9,592	93,871	66,059
2049	132,336	28,743	161,078	85,329	9,317	94,646	66,434
2050	133,342	28,884	162,226	86,379	9,041	95,420	66,807
2051	134,081	29,149	163,230	87,201	8,796	95,996	67,234
2052	134,824	29,414	164,238	88,023	8,550	96,573	67,665
2053	135,566	29,679	165,245	88,845	8,305	97,150	68,095
2054	136,305	29,944	166,249	89,667	8,059	97,726	68,523
2055	137,048	30,209	167,257	90,488	7,814	98,303	68,955
2056	137,787	30,475	168,262	91,310	7,569	98,879	69,383
2057	138,527	30,740	169,266	92,132	7,323	99,456	69,811
2058	139,272	31,005	170,277	92,954	7,078	100,032	70,245
2059	140,011	31,270	171,282	93,776	6,832	100,609	70,673
2060	140,754	31,536	172,289	94,598	6,587	101,185	71,104
2061	141,352	31,847	173,200	95,356	6,268	101,623	71,576
2062	141,951	32,159	174,110	96,114	5,948	102,062	72,048
2063	142,549	32,471	175,020	96,871	5,629	102,500	72,520
2064	143,145	32,786	175,931	97,629	5,309	102,938	72,992
2065	143,743	33,101	176,844	98,387	4,990	103,377	73,467
2066	144,342	33,416	177,757	99,145	4,670	103,815	73,942
2067	144,943	33,731	178,674	99,903	4,351	104,253	74,421
2068	145,542	34,045	179,587	100,661	4,031	104,692	74,896
2069	146,140	34,360	180,501	101,418	3,712	105,130	75,371
2070	146,739	34,675	181,414	102,176	3,392	105,568	75,846

Table A-4. Region D Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	317	1,132	1,449	2,846	0	2,846	(1,397)
2016	317	1,133	1,451	3,557	0	3,557	(2,106)
2017	318	1,135	1,453	3,557	0	3,557	(2,105)
2018	318	1,136	1,454	4,269	0	4,269	(2,814)
2019	319	1,137	1,456	4,980	0	4,980	(3,524)
2020	319	1,138	1,458	6,403	0	6,403	(4,945)
2021	320	1,142	1,461	6,429	0	6,429	(4,968)
2022	320	1,145	1,465	6,455	0	6,455	(4,990)
2023	321	1,148	1,469	6,481	0	6,481	(5,013)
2024	321	1,151	1,472	6,507	0	6,507	(5,035)
2025	322	1,155	1,476	6,534	0	6,534	(5,057)
2026	322	1,158	1,480	6,560	0	6,560	(5,080)
2027	323	1,161	1,484	6,586	0	6,586	(5,102)
2028	323	1,164	1,487	6,612	0	6,612	(5,125)
2029	324	1,167	1,491	6,638	0	6,638	(5,147)
2030	324	1,171	1,495	6,664	0	6,664	(5,169)
2031	324	1,172	1,496	6,679	0	6,679	(5,184)
2032	324	1,173	1,497	6,694	0	6,694	(5,198)
2033	324	1,174	1,497	6,709	0	6,709	(5,212)
2034	324	1,175	1,498	6,724	0	6,724	(5,226)
2035	324	1,176	1,499	6,740	0	6,740	(5,240)
2036	324	1,177	1,500	6,755	0	6,755	(5,254)
2037	324	1,178	1,501	6,770	0	6,770	(5,268)
2038	324	1,179	1,502	6,785	0	6,785	(5,283)
2039	324	1,180	1,503	6,800	0	6,800	(5,297)
2040	323	1,181	1,504	6,815	0	6,815	(5,311)
2041	323	1,181	1,504	6,808	0	6,808	(5,304)
2042	323	1,181	1,504	6,800	0	6,800	(5,297)
2043	323	1,181	1,504	6,793	0	6,793	(5,289)
2044	323	1,181	1,503	6,786	0	6,786	(5,282)
2045	323	1,181	1,503	6,779	0	6,779	(5,275)
2046	322	1,181	1,503	6,771	0	6,771	(5,268)
2047	322	1,181	1,503	6,764	0	6,764	(5,261)
2048	322	1,181	1,503	6,757	0	6,757	(5,254)
2049	322	1,181	1,503	6,749	0	6,749	(5,247)
2050	322	1,181	1,502	6,742	0	6,742	(5,240)
2051	322	1,181	1,502	6,741	0	6,741	(5,238)
2052	322	1,181	1,502	6,739	0	6,739	(5,237)
2053	322	1,181	1,502	6,738	0	6,738	(5,236)
2054	321	1,181	1,502	6,737	0	6,737	(5,235)
2055	321	1,181	1,502	6,736	0	6,736	(5,233)
2056	321	1,181	1,502	6,734	0	6,734	(5,232)
2057	321	1,181	1,502	6,733	0	6,733	(5,231)
2058	321	1,181	1,502	6,732	0	6,732	(5,230)
2059	321	1,181	1,502	6,730	0	6,730	(5,228)
2060	321	1,181	1,502	6,729	0	6,729	(5,227)
2061	321	1,181	1,502	6,729	0	6,729	(5,227)
2062	321	1,181	1,502	6,729	0	6,729	(5,227)
2063	321	1,181	1,502	6,729	0	6,729	(5,227)
2064	321	1,181	1,502	6,729	0	6,729	(5,227)
2065	321	1,181	1,502	6,729	0	6,729	(5,226)
2066	321	1,181	1,502	6,728	0	6,728	(5,226)
2067	321	1,181	1,502	6,728	0	6,728	(5,226)
2068	321	1,181	1,502	6,728	0	6,728	(5,226)
2069	321	1,181	1,502	6,728	0	6,728	(5,226)
2070	321	1,181	1,502	6,728	0	6,728	(5,226)

Table A-5. Region E Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	12,825	(1,243)	11,582	848	0	848	10,735
2016	16,770	(1,262)	15,508	1,059	0	1,059	14,448
2017	16,505	(1,281)	15,224	1,059	0	1,059	14,165
2018	16,594	(1,300)	15,294	1,271	0	1,271	14,023
2019	16,683	(1,319)	15,364	1,483	0	1,483	13,881
2020	16,772	(1,338)	15,434	1,907	0	1,907	13,527
2021	16,861	(1,352)	15,508	1,932	0	1,932	13,576
2022	16,978	(1,367)	15,612	1,958	0	1,958	13,654
2023	16,958	(1,381)	15,577	1,983	0	1,983	13,594
2024	16,938	(1,396)	15,542	2,008	0	2,008	13,533
2025	16,918	(1,411)	15,507	2,034	0	2,034	13,473
2026	16,897	(1,425)	15,472	2,059	0	2,059	13,413
2027	17,015	(1,440)	15,575	2,084	0	2,084	13,491
2028	17,133	(1,455)	15,678	2,109	0	2,109	13,569
2029	17,251	(1,469)	15,781	2,135	0	2,135	13,646
2030	17,368	(1,484)	15,884	2,160	0	2,160	13,724
2031	17,482	(1,499)	15,982	2,066	0	2,066	13,916
2032	17,595	(1,515)	16,081	1,973	0	1,973	14,108
2033	17,709	(1,530)	16,179	1,879	0	1,879	14,300
2034	17,822	(1,545)	16,277	1,785	0	1,785	14,492
2035	17,936	(1,561)	16,375	1,692	0	1,692	14,683
2036	18,049	(1,576)	16,473	1,598	0	1,598	14,875
2037	18,162	(1,591)	16,571	1,504	0	1,504	15,067
2038	18,276	(1,607)	16,669	1,410	0	1,410	15,259
2039	18,389	(1,622)	16,767	1,317	0	1,317	15,451
2040	18,503	(1,637)	16,865	1,223	0	1,223	15,642
2041	18,626	(1,659)	16,967	1,363	0	1,363	15,603
2042	18,749	(1,681)	17,068	1,504	0	1,504	15,564
2043	18,872	(1,703)	17,169	1,644	0	1,644	15,526
2044	18,996	(1,725)	17,271	1,784	0	1,784	15,487
2045	19,119	(1,747)	17,372	1,925	0	1,925	15,448
2046	19,242	(1,769)	17,474	2,065	0	2,065	15,409
2047	19,365	(1,790)	17,575	2,205	0	2,205	15,370
2048	19,489	(1,812)	17,676	2,345	0	2,345	15,331
2049	19,612	(1,834)	17,778	2,486	0	2,486	15,292
2050	19,735	(1,856)	17,879	2,626	0	2,626	15,253
2051	19,862	(1,877)	17,985	2,925	0	2,925	15,060
2052	19,989	(1,898)	18,091	3,224	0	3,224	14,867
2053	20,116	(1,918)	18,198	3,524	0	3,524	14,674
2054	20,243	(1,939)	18,304	3,823	0	3,823	14,481
2055	20,370	(1,960)	18,410	4,122	0	4,122	14,288
2056	20,497	(1,980)	18,516	4,421	0	4,421	14,095
2057	20,624	(2,001)	18,623	4,720	0	4,720	13,902
2058	20,751	(2,022)	18,729	5,020	0	5,020	13,709
2059	20,878	(2,042)	18,835	5,319	0	5,319	13,516
2060	21,005	(2,063)	18,941	5,618	0	5,618	13,323
2061	21,126	(2,083)	19,044	5,657	0	5,657	13,386
2062	21,248	(2,102)	19,146	5,696	0	5,696	13,450
2063	21,369	(2,122)	19,248	5,735	0	5,735	13,513
2064	21,491	(2,141)	19,350	5,774	0	5,774	13,576
2065	21,613	(2,161)	19,452	5,814	0	5,814	13,639
2066	21,734	(2,180)	19,554	5,853	0	5,853	13,702
2067	21,856	(2,199)	19,657	5,892	0	5,892	13,765
2068	21,978	(2,219)	19,759	5,931	0	5,931	13,828
2069	22,099	(2,238)	19,861	5,970	0	5,970	13,891
2070	22,221	(2,258)	19,963	6,009	0	6,009	13,954

Table A-6. Region F Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	2,324	1,757	4,080	1,119	0	1,119	2,962
2016	4,798	1,746	6,544	1,398	0	1,398	5,145
2017	5,233	1,735	6,967	1,398	0	1,398	5,569
2018	5,282	1,724	7,005	1,678	0	1,678	5,327
2019	5,330	1,713	7,043	1,958	0	1,958	5,085
2020	5,379	1,703	7,083	2,517	0	2,517	4,566
2021	5,428	1,724	7,152	2,548	0	2,548	4,604
2022	5,477	1,744	7,221	2,578	0	2,578	4,643
2023	5,526	1,765	7,290	2,609	0	2,609	4,682
2024	5,574	1,785	7,359	2,639	0	2,639	4,720
2025	5,623	1,805	7,428	2,670	0	2,670	4,759
2026	5,672	1,809	7,481	2,700	0	2,700	4,781
2027	5,721	1,829	7,550	2,731	0	2,731	4,819
2028	5,769	1,850	7,619	2,761	0	2,761	4,858
2029	5,818	1,870	7,688	2,792	0	2,792	4,897
2030	5,867	1,891	7,758	2,822	0	2,822	4,936
2031	5,911	1,910	7,821	2,850	0	2,850	4,971
2032	5,955	1,930	7,885	2,877	0	2,877	5,008
2033	5,999	1,950	7,949	2,905	0	2,905	5,044
2034	6,043	1,970	8,012	2,932	0	2,932	5,080
2035	6,087	1,990	8,076	2,960	0	2,960	5,116
2036	6,130	2,009	8,140	2,988	0	2,988	5,152
2037	6,174	2,029	8,204	3,015	0	3,015	5,188
2038	6,218	2,049	8,267	3,043	0	3,043	5,225
2039	6,262	2,069	8,331	3,070	0	3,070	5,261
2040	6,306	2,089	8,395	3,098	0	3,098	5,297
2041	6,356	2,108	8,464	3,125	0	3,125	5,339
2042	6,405	2,128	8,534	3,151	0	3,151	5,382
2043	6,455	2,149	8,603	3,178	0	3,178	5,425
2044	6,504	2,169	8,673	3,205	0	3,205	5,468
2045	6,554	2,189	8,743	3,232	0	3,232	5,511
2046	6,603	2,209	8,812	3,258	0	3,258	5,554
2047	6,653	2,229	8,882	3,285	0	3,285	5,597
2048	6,703	2,249	8,952	3,312	0	3,312	5,640
2049	6,752	2,269	9,021	3,338	0	3,338	5,683
2050	6,802	2,289	9,091	3,365	0	3,365	5,726
2051	6,856	2,309	9,165	3,392	0	3,392	5,773
2052	6,911	2,329	9,240	3,419	0	3,419	5,821
2053	6,966	2,349	9,315	3,447	0	3,447	5,868
2054	7,020	2,369	9,389	3,474	0	3,474	5,916
2055	7,075	2,389	9,464	3,501	0	3,501	5,963
2056	7,129	2,409	9,539	3,528	0	3,528	6,011
2057	7,184	2,430	9,614	3,555	0	3,555	6,058
2058	7,239	2,450	9,688	3,583	0	3,583	6,106
2059	7,293	2,470	9,763	3,610	0	3,610	6,153
2060	7,348	2,490	9,837	3,637	0	3,637	6,200
2061	7,404	2,509	9,914	3,667	0	3,667	6,246
2062	7,461	2,529	9,990	3,698	0	3,698	6,292
2063	7,517	2,549	10,066	3,728	0	3,728	6,338
2064	7,573	2,569	10,142	3,759	0	3,759	6,384
2065	7,630	2,589	10,218	3,789	0	3,789	6,429
2066	7,686	2,609	10,295	3,819	0	3,819	6,475
2067	7,742	2,629	10,371	3,850	0	3,850	6,521
2068	7,799	2,649	10,447	3,880	0	3,880	6,567
2069	7,855	2,668	10,523	3,911	0	3,911	6,613
2070	7,911	2,691	10,603	3,941	0	3,941	6,662

Table A-7. Region G Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	3,978	1,355	5,333	3,437	8	3,444	1,889
2016	5,762	1,436	7,197	4,296	9	4,305	2,892
2017	7,610	1,517	9,126	4,296	11	4,307	4,819
2018	7,697	1,597	9,295	5,155	13	5,168	4,127
2019	7,787	1,678	9,465	6,012	15	6,028	3,437
2020	7,880	1,759	9,639	7,732	17	7,749	1,890
2021	7,977	1,832	9,809	9,177	17	9,194	615
2022	8,077	1,905	9,981	10,622	17	10,639	(658)
2023	8,175	1,977	10,152	12,067	17	12,084	(1,932)
2024	8,270	2,050	10,320	13,512	17	13,529	(3,209)
2025	8,364	2,123	10,487	14,957	17	14,974	(4,487)
2026	8,460	2,196	10,656	16,402	17	16,419	(5,763)
2027	8,560	2,269	10,829	17,847	17	17,864	(7,035)
2028	8,660	2,341	11,001	19,292	17	19,309	(8,308)
2029	8,759	2,414	11,174	20,737	17	20,754	(9,580)
2030	8,859	2,487	11,346	22,182	17	22,199	(10,853)
2031	8,973	2,563	11,536	23,460	16	23,476	(11,940)
2032	9,087	2,640	11,727	24,738	15	24,753	(13,027)
2033	9,201	2,716	11,917	26,017	14	26,031	(14,114)
2034	9,315	2,793	12,108	27,295	13	27,308	(15,201)
2035	9,429	2,869	12,298	28,574	12	28,586	(16,288)
2036	9,543	2,945	12,489	29,852	11	29,863	(17,375)
2037	9,657	3,022	12,679	31,131	10	31,141	(18,462)
2038	9,771	3,098	12,869	32,409	9	32,418	(19,549)
2039	9,885	3,175	13,060	33,688	8	33,696	(20,636)
2040	9,999	3,251	13,250	34,966	7	34,973	(21,723)
2041	10,123	3,342	13,464	36,307	7	36,314	(22,850)
2042	10,246	3,432	13,678	37,648	7	37,655	(23,976)
2043	10,370	3,523	13,893	38,989	7	38,996	(25,103)
2044	10,493	3,613	14,107	40,330	7	40,337	(26,230)
2045	10,617	3,704	14,321	41,671	7	41,678	(27,357)
2046	10,740	3,794	14,535	43,012	7	43,019	(28,484)
2047	10,864	3,885	14,749	44,353	7	44,360	(29,611)
2048	10,987	3,976	14,963	45,694	7	45,701	(30,738)
2049	11,111	4,066	15,177	47,035	7	47,042	(31,865)
2050	11,234	4,157	15,391	48,376	7	48,383	(32,992)
2051	11,352	4,261	15,613	49,596	7	49,603	(33,990)
2052	11,470	4,365	15,835	50,816	7	50,823	(34,988)
2053	11,588	4,470	16,057	52,037	7	52,044	(35,986)
2054	11,706	4,574	16,279	53,257	7	53,264	(36,985)
2055	11,824	4,678	16,502	54,477	7	54,484	(37,983)
2056	11,941	4,782	16,724	55,698	7	55,705	(38,981)
2057	12,059	4,886	16,946	56,918	7	56,925	(39,979)
2058	12,177	4,991	17,168	58,138	7	58,145	(40,977)
2059	12,295	5,095	17,390	59,358	7	59,365	(41,976)
2060	12,413	5,199	17,612	60,579	7	60,586	(42,974)
2061	12,536	5,308	17,844	61,533	7	61,540	(43,695)
2062	12,659	5,417	18,077	62,486	7	62,493	(44,417)
2063	12,783	5,526	18,309	63,440	7	63,447	(45,138)
2064	12,906	5,635	18,541	64,394	7	64,401	(45,860)
2065	13,030	5,744	18,774	65,348	7	65,355	(46,581)
2066	13,153	5,853	19,006	66,302	7	66,309	(47,303)
2067	13,276	5,962	19,238	67,256	7	67,263	(48,024)
2068	13,400	6,071	19,471	68,209	7	68,216	(48,746)
2069	13,523	6,180	19,703	69,163	7	69,170	(49,467)
2070	13,646	6,289	19,935	70,117	7	70,124	(50,189)

Table A-8. Region H Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	18,599	15,344	33,944	2,173	3,443	5,616	28,328
2016	20,632	15,479	36,110	2,717	4,303	7,020	29,090
2017	23,562	15,655	39,217	2,717	5,164	7,881	31,336
2018	23,446	15,832	39,278	3,260	6,025	9,285	29,993
2019	23,314	15,872	39,187	3,803	6,885	10,689	28,498
2020	23,212	15,913	39,125	4,890	7,746	12,636	26,489
2021	23,114	15,958	39,072	5,848	8,520	14,368	24,704
2022	23,246	16,002	39,248	6,806	9,294	16,100	23,148
2023	23,376	16,046	39,422	7,764	10,068	17,832	21,590
2024	23,505	16,164	39,668	8,722	10,842	19,564	20,104
2025	23,638	16,281	39,919	9,680	11,616	21,296	18,623
2026	23,770	16,399	40,169	10,638	12,390	23,028	17,141
2027	23,906	16,516	40,422	11,596	13,164	24,760	15,662
2028	24,040	16,634	40,674	12,554	13,938	26,492	14,182
2029	24,174	16,752	40,926	13,512	14,712	28,224	12,702
2030	24,308	16,869	41,178	14,470	15,486	29,956	11,222
2031	24,448	16,986	41,434	15,415	16,252	31,667	9,766
2032	24,588	17,102	41,690	16,360	17,019	33,378	8,311
2033	24,728	17,218	41,945	17,304	17,785	35,090	6,856
2034	24,867	17,337	42,204	18,249	18,552	36,801	5,403
2035	25,010	17,456	42,466	19,194	19,318	38,512	3,954
2036	25,150	17,575	42,724	20,139	20,084	40,223	2,501
2037	25,290	17,694	42,983	21,084	20,851	41,934	1,049
2038	25,429	17,812	43,242	22,028	21,617	43,646	(404)
2039	25,569	17,931	43,500	22,973	22,384	45,357	(1,856)
2040	25,709	18,050	43,759	23,918	23,150	47,068	(3,309)
2041	25,864	18,168	44,032	24,905	23,890	48,795	(4,763)
2042	26,017	18,285	44,302	25,892	24,630	50,522	(6,220)
2043	26,167	18,403	44,569	26,879	25,370	52,249	(7,680)
2044	26,316	18,523	44,839	27,866	26,110	53,976	(9,138)
2045	26,469	18,642	45,111	28,853	26,851	55,704	(10,593)
2046	26,621	18,762	45,383	29,840	27,591	57,431	(12,048)
2047	26,774	18,881	45,655	30,827	28,331	59,158	(13,503)
2048	26,929	19,001	45,930	31,814	29,071	60,885	(14,955)
2049	27,079	19,120	46,199	32,801	29,811	62,612	(16,413)
2050	27,231	19,240	46,471	33,788	30,551	64,339	(17,868)
2051	27,409	19,360	46,769	34,726	30,797	65,522	(18,753)
2052	27,584	19,480	47,064	35,663	31,042	66,706	(19,642)
2053	27,758	19,600	47,358	36,601	31,288	67,889	(20,530)
2054	27,933	19,729	47,662	37,538	31,534	69,072	(21,410)
2055	28,111	19,857	47,968	38,476	31,780	70,256	(22,287)
2056	28,285	19,986	48,272	39,414	32,025	71,439	(23,167)
2057	28,460	20,115	48,575	40,351	32,271	72,622	(24,047)
2058	28,635	20,244	48,878	41,289	32,517	73,805	(24,927)
2059	28,815	20,372	49,188	42,226	32,762	74,989	(25,801)
2060	28,990	20,501	49,491	43,164	33,008	76,172	(26,681)
2061	29,179	20,630	49,809	44,107	33,217	77,324	(27,515)
2062	29,364	20,759	50,123	45,049	33,426	78,476	(28,352)
2063	29,553	20,889	50,441	45,992	33,636	79,627	(29,186)
2064	29,744	21,026	50,770	46,934	33,845	80,779	(30,009)
2065	29,929	21,164	51,093	47,877	34,054	81,931	(30,838)
2066	30,121	21,302	51,423	48,820	34,263	83,083	(31,660)
2067	30,310	21,439	51,749	49,762	34,472	84,235	(32,486)
2068	30,498	21,577	52,075	50,705	34,682	85,386	(33,311)
2069	30,686	21,715	52,401	51,647	34,891	86,538	(34,137)
2070	30,875	21,853	52,728	52,590	35,100	87,690	(34,962)

Table A-9. Region J Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	138	1,189	1,327	53	65	118	1,209
2016	138	1,204	1,342	66	82	148	1,194
2017	138	1,219	1,357	66	98	164	1,193
2018	138	1,234	1,373	79	114	194	1,179
2019	138	1,250	1,388	93	131	223	1,165
2020	139	1,265	1,403	119	147	266	1,137
2021	139	1,274	1,412	119	147	266	1,146
2022	139	1,283	1,422	119	147	266	1,156
2023	139	1,291	1,431	119	147	266	1,165
2024	139	1,300	1,440	119	147	266	1,174
2025	140	1,309	1,449	119	147	266	1,183
2026	140	1,318	1,458	119	147	266	1,192
2027	140	1,327	1,467	119	147	266	1,201
2028	140	1,336	1,476	119	147	266	1,210
2029	140	1,345	1,485	119	147	266	1,219
2030	141	1,354	1,495	119	147	266	1,229
2031	141	1,363	1,504	119	147	266	1,238
2032	141	1,372	1,513	119	147	266	1,247
2033	141	1,381	1,522	119	147	266	1,256
2034	141	1,390	1,531	119	147	266	1,265
2035	141	1,399	1,540	119	147	266	1,274
2036	141	1,408	1,549	119	147	266	1,283
2037	141	1,418	1,559	119	147	266	1,293
2038	141	1,427	1,568	119	147	266	1,302
2039	141	1,436	1,577	119	147	266	1,311
2040	141	1,445	1,586	119	147	266	1,320
2041	141	1,454	1,595	119	147	266	1,329
2042	141	1,463	1,605	119	147	266	1,339
2043	142	1,473	1,614	119	147	266	1,348
2044	142	1,482	1,624	119	147	266	1,358
2045	142	1,492	1,634	119	147	266	1,368
2046	142	1,501	1,643	119	147	266	1,377
2047	142	1,510	1,653	119	147	266	1,387
2048	142	1,520	1,662	119	147	266	1,396
2049	143	1,529	1,672	119	147	266	1,406
2050	143	1,538	1,681	119	147	266	1,415
2051	143	1,547	1,690	119	147	266	1,424
2052	143	1,557	1,700	119	147	266	1,434
2053	143	1,566	1,709	119	147	266	1,443
2054	144	1,575	1,718	119	147	266	1,452
2055	144	1,584	1,727	119	147	266	1,461
2056	144	1,593	1,737	119	147	266	1,471
2057	144	1,602	1,746	119	147	266	1,480
2058	144	1,611	1,755	119	147	266	1,489
2059	144	1,620	1,764	119	147	266	1,498
2060	145	1,629	1,774	119	147	266	1,508
2061	145	1,638	1,783	119	147	266	1,517
2062	145	1,647	1,792	119	147	266	1,526
2063	145	1,656	1,801	119	147	266	1,535
2064	145	1,665	1,810	119	147	266	1,544
2065	145	1,673	1,819	119	147	266	1,553
2066	146	1,682	1,828	119	147	266	1,562
2067	146	1,691	1,837	119	147	266	1,571
2068	146	1,700	1,846	119	147	266	1,580
2069	146	1,709	1,855	119	147	266	1,589
2070	146	1,718	1,864	119	147	266	1,598

Table A-10. Region K Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	26,749	(3,088)	23,661	11,609	0	11,609	12,052
2016	38,638	26	38,664	14,512	0	14,512	24,152
2017	38,367	27	38,394	14,512	0	14,512	23,883
2018	37,656	28	37,684	17,414	0	17,414	20,270
2019	38,053	29	38,082	20,316	0	20,316	17,766
2020	38,540	30	38,569	26,121	0	26,121	12,448
2021	39,134	22	39,156	26,683	0	26,683	12,473
2022	39,610	15	39,625	27,245	0	27,245	12,380
2023	40,121	7	40,128	27,807	0	27,807	12,321
2024	40,615	(0)	40,614	28,369	0	28,369	12,245
2025	41,140	(8)	41,133	28,932	0	28,932	12,201
2026	41,713	(15)	41,698	29,494	0	29,494	12,204
2027	42,287	(23)	42,264	30,056	0	30,056	12,208
2028	42,916	(30)	42,885	30,618	0	30,618	12,267
2029	43,544	(38)	43,506	31,180	0	31,180	12,326
2030	44,173	(45)	44,128	31,742	0	31,742	12,386
2031	44,841	(60)	44,781	32,395	0	32,395	12,386
2032	45,510	(75)	45,435	33,049	0	33,049	12,386
2033	46,178	(90)	46,088	33,702	0	33,702	12,386
2034	46,843	(105)	46,739	34,355	0	34,355	12,384
2035	47,512	(119)	47,393	35,009	0	35,009	12,384
2036	48,180	(134)	48,046	35,662	0	35,662	12,384
2037	48,849	(149)	48,700	36,315	0	36,315	12,385
2038	49,514	(164)	49,350	36,968	0	36,968	12,382
2039	50,183	(179)	50,004	37,622	0	37,622	12,382
2040	50,851	(193)	50,658	38,275	0	38,275	12,383
2041	51,386	(218)	51,168	38,884	0	38,884	12,284
2042	51,917	(242)	51,675	39,493	0	39,493	12,183
2043	52,451	(266)	52,186	40,102	0	40,102	12,084
2044	52,986	(290)	52,696	40,711	0	40,711	11,986
2045	53,520	(314)	53,206	41,320	0	41,320	11,887
2046	54,052	(338)	53,714	41,928	0	41,928	11,785
2047	54,586	(362)	54,224	42,537	0	42,537	11,687
2048	55,121	(386)	54,735	43,146	0	43,146	11,588
2049	55,655	(410)	55,245	43,755	0	43,755	11,490
2050	56,187	(434)	55,752	44,392	0	44,392	11,388
2051	56,672	(465)	56,207	45,014	0	45,014	11,192
2052	57,158	(496)	56,661	45,665	0	45,665	10,997
2053	57,640	(527)	57,113	46,315	0	46,315	10,798
2054	58,126	(559)	57,567	46,966	0	46,966	10,602
2055	58,608	(590)	58,019	47,616	0	47,616	10,403
2056	59,094	(621)	58,473	48,266	0	48,266	10,207
2057	59,576	(652)	58,925	48,917	0	48,917	10,008
2058	60,062	(683)	59,379	49,567	0	49,567	9,812
2059	60,545	(714)	59,831	50,218	0	50,218	9,613
2060	61,030	(745)	60,285	50,894	0	50,894	9,417
2061	61,593	(786)	60,808	51,712	0	51,712	9,096
2062	62,157	(827)	61,330	52,555	0	52,555	8,774
2063	62,720	(869)	61,852	53,399	0	53,399	8,453
2064	63,284	(910)	62,374	54,243	0	54,243	8,131
2065	63,850	(951)	62,899	55,087	0	55,087	7,812
2066	64,413	(992)	63,421	55,930	0	55,930	7,491
2067	64,977	(1,034)	63,943	56,774	0	56,774	7,169
2068	65,540	(1,075)	64,465	57,618	0	57,618	6,847
2069	66,103	(1,116)	64,987	58,461	0	58,461	6,526
2070	66,670	(1,158)	65,512	59,305	0	59,305	6,207

Table A-11. Region L Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	12,952	4,953	17,905	7,998	0	7,998	9,907
2016	15,031	4,999	20,031	9,997	0	9,997	10,034
2017	15,570	5,046	20,616	9,997	0	9,997	10,619
2018	15,536	5,092	20,628	11,997	0	11,997	8,631
2019	15,497	5,139	20,636	13,996	0	13,996	6,640
2020	15,568	5,185	20,754	17,995	0	17,995	2,759
2021	15,439	5,246	20,685	17,892	0	17,892	2,794
2022	15,487	5,307	20,794	17,788	0	17,788	3,006
2023	15,581	5,368	20,948	17,685	0	17,685	3,263
2024	15,690	5,429	21,119	17,582	0	17,582	3,537
2025	15,793	5,489	21,283	17,479	0	17,479	3,804
2026	13,485	5,550	19,036	17,375	0	17,375	1,660
2027	11,810	5,611	17,421	17,272	0	17,272	149
2028	10,550	5,672	16,222	17,169	0	17,169	(946)
2029	9,291	5,733	15,024	17,065	0	17,065	(2,041)
2030	8,032	5,793	13,825	16,962	0	16,962	(3,137)
2031	7,995	5,847	13,842	17,042	0	17,042	(3,200)
2032	7,958	5,901	13,859	17,122	0	17,122	(3,262)
2033	7,921	5,955	13,876	17,202	0	17,202	(3,326)
2034	7,884	6,009	13,893	17,282	0	17,282	(3,388)
2035	7,809	6,063	13,872	17,362	0	17,362	(3,489)
2036	7,307	6,117	13,424	17,441	0	17,441	(4,017)
2037	7,264	6,171	13,435	17,521	0	17,521	(4,086)
2038	7,249	6,225	13,474	17,601	0	17,601	(4,127)
2039	7,234	6,279	13,513	17,681	0	17,681	(4,168)
2040	7,219	6,333	13,552	17,761	0	17,761	(4,209)
2041	7,205	6,384	13,589	18,960	0	18,960	(5,370)
2042	7,192	6,436	13,628	20,159	0	20,159	(6,531)
2043	7,178	6,488	13,666	21,358	0	21,358	(7,692)
2044	7,164	6,539	13,704	22,557	0	22,557	(8,853)
2045	7,145	6,591	13,736	23,756	0	23,756	(10,019)
2046	7,170	6,643	13,812	24,954	0	24,954	(11,142)
2047	7,194	6,694	13,888	26,153	0	26,153	(12,265)
2048	7,218	6,746	13,964	27,352	0	27,352	(13,388)
2049	7,242	6,798	14,040	28,551	0	28,551	(14,511)
2050	7,267	6,849	14,116	29,750	0	29,750	(15,634)
2051	7,292	6,898	14,191	31,777	0	31,777	(17,586)
2052	7,318	6,947	14,265	33,804	0	33,804	(19,539)
2053	7,344	6,996	14,340	35,831	0	35,831	(21,491)
2054	7,369	7,045	14,415	37,858	0	37,858	(23,443)
2055	7,395	7,094	14,490	39,885	0	39,885	(25,395)
2056	7,421	7,143	14,564	41,912	0	41,912	(27,348)
2057	7,447	7,192	14,639	43,939	0	43,939	(29,300)
2058	7,472	7,241	14,714	45,966	0	45,966	(31,252)
2059	7,498	7,290	14,788	47,993	0	47,993	(33,205)
2060	7,524	7,339	14,863	50,020	0	50,020	(35,157)
2061	7,550	7,389	14,939	51,733	0	51,733	(36,794)
2062	7,576	7,438	15,014	53,445	0	53,445	(38,431)
2063	7,602	7,488	15,090	55,158	0	55,158	(40,068)
2064	7,628	7,538	15,166	56,870	0	56,870	(41,705)
2065	7,654	7,587	15,242	58,583	0	58,583	(43,341)
2066	7,681	7,637	15,317	60,296	0	60,296	(44,978)
2067	7,707	7,686	15,393	62,008	0	62,008	(46,615)
2068	7,733	7,736	15,469	63,721	0	63,721	(48,252)
2069	7,759	7,785	15,544	65,433	0	65,433	(49,889)
2070	7,785	7,835	15,620	67,146	0	67,146	(51,526)

Table A-12. Region M Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	2,139	2,983	5,121	1,869	0	1,869	3,252
2016	2,685	3,058	5,743	2,337	0	2,337	3,406
2017	2,743	3,133	5,876	2,337	0	2,337	3,539
2018	2,804	3,208	6,012	2,804	0	2,804	3,208
2019	2,859	3,283	6,142	3,271	0	3,271	2,871
2020	2,921	3,358	6,279	4,206	0	4,206	2,073
2021	2,979	3,432	6,411	5,102	0	5,102	1,310
2022	3,041	3,507	6,547	5,997	0	5,997	550
2023	3,099	3,581	6,680	6,893	0	6,893	(213)
2024	3,157	3,655	6,813	7,788	0	7,788	(976)
2025	3,219	3,730	6,948	8,684	0	8,684	(1,736)
2026	3,277	3,804	7,081	9,580	0	9,580	(2,498)
2027	3,338	3,879	7,217	10,475	0	10,475	(3,258)
2028	3,397	3,953	7,350	11,371	0	11,371	(4,021)
2029	3,458	4,027	7,486	12,266	0	12,266	(4,781)
2030	3,517	4,102	7,618	13,162	0	13,162	(5,544)
2031	3,579	4,176	7,755	14,426	0	14,426	(6,672)
2032	3,638	4,250	7,888	15,691	0	15,691	(7,803)
2033	3,700	4,324	8,024	16,955	0	16,955	(8,931)
2034	3,762	4,398	8,160	18,219	0	18,219	(10,059)
2035	3,822	4,472	8,294	19,484	0	19,484	(11,190)
2036	3,884	4,546	8,430	20,748	0	20,748	(12,318)
2037	3,946	4,620	8,566	22,012	0	22,012	(13,446)
2038	4,005	4,694	8,699	23,276	0	23,276	(14,577)
2039	4,068	4,768	8,836	24,541	0	24,541	(15,705)
2040	4,127	4,842	8,969	25,805	0	25,805	(16,836)
2041	4,190	4,914	9,104	27,648	0	27,648	(18,544)
2042	4,253	4,985	9,238	29,490	0	29,490	(20,252)
2043	4,316	5,057	9,373	31,333	0	31,333	(21,960)
2044	4,376	5,128	9,504	33,175	0	33,175	(23,671)
2045	4,439	5,200	9,639	35,018	0	35,018	(25,379)
2046	4,502	5,271	9,774	36,861	0	36,861	(27,087)
2047	4,565	5,343	9,908	38,703	0	38,703	(28,795)
2048	4,625	5,415	10,040	40,546	0	40,546	(30,506)
2049	4,689	5,486	10,175	42,388	0	42,388	(32,214)
2050	4,752	5,558	10,309	44,231	0	44,231	(33,922)
2051	4,816	5,632	10,448	46,366	0	46,366	(35,918)
2052	4,879	5,707	10,586	48,500	0	48,500	(37,914)
2053	4,943	5,782	10,725	50,635	0	50,635	(39,909)
2054	5,007	5,856	10,864	52,769	0	52,769	(41,905)
2055	5,071	5,931	11,002	54,904	0	54,904	(43,901)
2056	5,132	6,006	11,138	57,038	0	57,038	(45,900)
2057	5,196	6,081	11,276	59,173	0	59,173	(47,896)
2058	5,260	6,155	11,415	61,307	0	61,307	(49,892)
2059	5,324	6,230	11,553	63,442	0	63,442	(51,888)
2060	5,387	6,305	11,692	65,576	0	65,576	(53,884)
2061	5,450	6,374	11,824	67,830	0	67,830	(56,006)
2062	5,513	6,443	11,956	70,083	0	70,083	(58,127)
2063	5,572	6,512	12,085	72,337	0	72,337	(60,252)
2064	5,635	6,582	12,217	74,590	0	74,590	(62,374)
2065	5,698	6,651	12,349	76,844	0	76,844	(64,495)
2066	5,760	6,720	12,481	79,098	0	79,098	(66,617)
2067	5,820	6,789	12,609	81,351	0	81,351	(68,742)
2068	5,883	6,859	12,741	83,605	0	83,605	(70,863)
2069	5,945	6,928	12,873	85,858	0	85,858	(72,985)
2070	6,008	6,997	13,005	88,112	0	88,112	(75,107)

Table A-13. Region N Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	859	778	1,637	1,080	0	1,080	557
2016	3,419	799	4,218	1,350	0	1,350	2,868
2017	3,441	820	4,261	1,350	0	1,350	2,911
2018	3,463	840	4,304	1,620	0	1,620	2,684
2019	3,486	861	4,346	1,890	0	1,890	2,456
2020	3,508	881	4,389	2,430	0	2,430	1,959
2021	3,530	889	4,419	2,956	0	2,956	1,463
2022	3,552	897	4,450	3,482	0	3,482	968
2023	3,575	905	4,480	4,008	0	4,008	472
2024	3,597	913	4,510	4,534	0	4,534	(24)
2025	3,619	921	4,540	5,060	0	5,060	(520)
2026	3,641	928	4,570	5,586	0	5,586	(1,016)
2027	3,664	936	4,600	6,112	0	6,112	(1,512)
2028	3,686	944	4,630	6,638	0	6,638	(2,008)
2029	3,708	952	4,660	7,164	0	7,164	(2,504)
2030	3,731	960	4,690	7,690	0	7,690	(3,000)
2031	3,743	965	4,708	8,073	0	8,073	(3,365)
2032	3,756	970	4,725	8,455	0	8,455	(3,730)
2033	3,769	974	4,743	8,838	0	8,838	(4,095)
2034	3,781	979	4,760	9,221	0	9,221	(4,460)
2035	3,794	984	4,778	9,604	0	9,604	(4,826)
2036	3,806	989	4,795	9,986	0	9,986	(5,191)
2037	3,819	994	4,813	10,369	0	10,369	(5,556)
2038	3,832	999	4,830	10,752	0	10,752	(5,921)
2039	3,844	1,004	4,848	11,134	0	11,134	(6,286)
2040	3,857	1,008	4,866	11,517	0	11,517	(6,651)
2041	3,865	1,016	4,881	11,507	0	11,507	(6,626)
2042	3,872	1,025	4,897	11,497	0	11,497	(6,600)
2043	3,880	1,033	4,913	11,486	0	11,486	(6,574)
2044	3,888	1,041	4,928	11,476	0	11,476	(6,548)
2045	3,895	1,049	4,944	11,466	0	11,466	(6,522)
2046	3,903	1,057	4,960	11,456	0	11,456	(6,496)
2047	3,911	1,065	4,976	11,446	0	11,446	(6,470)
2048	3,918	1,073	4,991	11,435	0	11,435	(6,444)
2049	3,926	1,081	5,007	11,425	0	11,425	(6,418)
2050	3,933	1,089	5,023	11,415	0	11,415	(6,392)
2051	3,941	1,094	5,035	11,438	0	11,438	(6,403)
2052	3,948	1,099	5,047	11,462	0	11,462	(6,414)
2053	3,956	1,104	5,060	11,485	0	11,485	(6,425)
2054	3,963	1,109	5,072	11,509	0	11,509	(6,436)
2055	3,971	1,114	5,084	11,532	0	11,532	(6,448)
2056	3,978	1,118	5,097	11,555	0	11,555	(6,459)
2057	3,986	1,123	5,109	11,579	0	11,579	(6,470)
2058	3,993	1,128	5,121	11,602	0	11,602	(6,481)
2059	4,001	1,133	5,134	11,626	0	11,626	(6,492)
2060	4,008	1,138	5,146	11,649	0	11,649	(6,503)
2061	4,014	1,140	5,154	11,662	0	11,662	(6,508)
2062	4,019	1,143	5,162	11,676	0	11,676	(6,514)
2063	4,024	1,146	5,170	11,689	0	11,689	(6,519)
2064	4,030	1,148	5,178	11,702	0	11,702	(6,524)
2065	4,035	1,151	5,186	11,716	0	11,716	(6,530)
2066	4,041	1,153	5,194	11,729	0	11,729	(6,535)
2067	4,046	1,156	5,202	11,742	0	11,742	(6,540)
2068	4,051	1,158	5,210	11,755	0	11,755	(6,546)
2069	4,057	1,161	5,218	11,769	0	11,769	(6,551)
2070	4,062	1,164	5,226	11,782	0	11,782	(6,556)

Table A-14. Region O Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	493	944	1,437	1,162	0	1,162	275
2016	888	950	1,838	1,452	0	1,452	386
2017	4,359	955	5,314	1,452	0	1,452	3,862
2018	4,392	961	5,353	1,743	0	1,743	3,610
2019	4,425	966	5,391	2,033	0	2,033	3,358
2020	4,458	972	5,430	2,614	0	2,614	2,816
2021	4,491	983	5,474	2,635	0	2,635	2,839
2022	4,524	994	5,518	2,655	0	2,655	2,862
2023	4,557	1,005	5,562	2,676	0	2,676	2,886
2024	4,591	1,016	5,607	2,697	0	2,697	2,910
2025	4,624	1,027	5,652	2,718	0	2,718	2,934
2026	4,658	1,039	5,697	2,738	0	2,738	2,958
2027	4,692	1,050	5,741	2,759	0	2,759	2,982
2028	4,725	1,061	5,786	2,780	0	2,780	3,006
2029	4,759	1,072	5,831	2,800	0	2,800	3,030
2030	4,792	1,083	5,875	2,821	0	2,821	3,054
2031	4,828	1,094	5,922	2,842	0	2,842	3,080
2032	4,863	1,105	5,968	2,862	0	2,862	3,106
2033	4,898	1,117	6,015	2,883	0	2,883	3,132
2034	4,933	1,128	6,061	2,903	0	2,903	3,158
2035	4,968	1,139	6,107	2,924	0	2,924	3,184
2036	5,004	1,150	6,154	2,944	0	2,944	3,210
2037	5,039	1,161	6,200	2,965	0	2,965	3,236
2038	5,074	1,173	6,247	2,985	0	2,985	3,262
2039	5,109	1,184	6,293	3,006	0	3,006	3,288
2040	5,144	1,195	6,339	3,026	0	3,026	3,313
2041	5,185	1,207	6,392	3,049	0	3,049	3,343
2042	5,226	1,219	6,445	3,073	0	3,073	3,373
2043	5,267	1,232	6,498	3,096	0	3,096	3,402
2044	5,308	1,244	6,551	3,120	0	3,120	3,432
2045	5,348	1,256	6,604	3,143	0	3,143	3,461
2046	5,389	1,268	6,657	3,166	0	3,166	3,491
2047	5,430	1,280	6,710	3,190	0	3,190	3,521
2048	5,471	1,293	6,763	3,213	0	3,213	3,550
2049	5,511	1,305	6,816	3,237	0	3,237	3,580
2050	5,552	1,317	6,869	3,260	0	3,260	3,609
2051	5,595	1,329	6,923	3,284	0	3,284	3,639
2052	5,638	1,340	6,978	3,309	0	3,309	3,669
2053	5,680	1,351	7,032	3,333	0	3,333	3,699
2054	5,723	1,363	7,086	3,357	0	3,357	3,729
2055	5,766	1,374	7,140	3,382	0	3,382	3,758
2056	5,808	1,386	7,194	3,406	0	3,406	3,788
2057	5,851	1,397	7,248	3,430	0	3,430	3,818
2058	5,894	1,409	7,302	3,454	0	3,454	3,848
2059	5,936	1,420	7,357	3,479	0	3,479	3,878
2060	5,979	1,432	7,411	3,503	0	3,503	3,908
2061	6,022	1,443	7,465	3,529	0	3,529	3,936
2062	6,064	1,455	7,519	3,555	0	3,555	3,964
2063	6,107	1,466	7,573	3,581	0	3,581	3,992
2064	6,150	1,478	7,627	3,607	0	3,607	4,020
2065	6,192	1,489	7,681	3,634	0	3,634	4,048
2066	6,235	1,501	7,735	3,660	0	3,660	4,076
2067	6,277	1,512	7,790	3,686	0	3,686	4,104
2068	6,320	1,524	7,844	3,712	0	3,712	4,132
2069	6,363	1,535	7,898	3,738	0	3,738	4,160
2070	6,405	1,546	7,952	3,764	0	3,764	4,190

Table A-15. Region P Participating Utilities' Total Estimated Savings Compared to Their Collective Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	97	41	138	48	0	48	90
2016	98	41	138	61	0	61	78
2017	98	41	138	61	0	61	78
2018	98	41	139	73	0	73	66
2019	98	41	139	85	0	85	54
2020	98	41	139	109	0	109	30
2021	99	41	140	115	0	115	24
2022	99	41	140	121	0	121	19
2023	99	41	140	127	0	127	13
2024	99	41	141	133	0	133	7
2025	100	42	141	140	0	140	2
2026	100	42	142	146	0	146	(4)
2027	100	42	142	152	0	152	(10)
2028	100	42	142	158	0	158	(15)
2029	100	42	143	164	0	164	(21)
2030	101	43	143	170	0	170	(27)
2031	101	43	143	177	0	177	(33)
2032	101	43	144	183	0	183	(40)
2033	101	43	144	190	0	190	(46)
2034	101	43	144	197	0	197	(52)
2035	101	43	145	204	0	204	(59)
2036	101	44	145	210	0	210	(65)
2037	102	44	145	217	0	217	(72)
2038	102	44	146	224	0	224	(78)
2039	102	44	146	230	0	230	(84)
2040	102	44	146	237	0	237	(91)
2041	102	44	147	247	0	247	(100)
2042	103	44	147	256	0	256	(109)
2043	103	45	147	266	0	266	(119)
2044	103	45	148	275	0	275	(128)
2045	103	45	148	285	0	285	(137)
2046	103	45	148	295	0	295	(146)
2047	104	45	149	304	0	304	(156)
2048	104	45	149	314	0	314	(165)
2049	104	45	149	323	0	323	(174)
2050	104	45	150	333	0	333	(183)
2051	104	46	150	333	0	333	(183)
2052	105	46	150	332	0	332	(182)
2053	105	46	151	332	0	332	(181)
2054	105	46	151	331	0	331	(180)
2055	105	46	151	331	0	331	(180)
2056	106	46	152	331	0	331	(179)
2057	106	46	152	330	0	330	(178)
2058	106	46	153	330	0	330	(177)
2059	106	47	153	329	0	329	(176)
2060	107	47	153	329	0	329	(176)
2061	107	47	154	330	0	330	(176)
2062	107	47	154	330	0	330	(176)
2063	107	47	154	331	0	331	(177)
2064	108	47	155	332	0	332	(177)
2065	108	47	155	333	0	333	(177)
2066	108	47	155	333	0	333	(178)
2067	108	47	156	334	0	334	(178)
2068	109	48	156	335	0	335	(178)
2069	109	48	156	335	0	335	(179)
2070	109	48	157	336	0	336	(179)

Intentionally Left Blank

Appendix B – Invited and Participant Utilities

Table B-1. Region A Invited and Participating Utilities

Region A		
Utilities Invited	**Accepted**	**Declined**
Amarillo	X	
Borger	X	
Canyon	X	
Dalhart	X	
Dumas	X	
Pampa		X
Perryton	X	

Table B-2. Region B Invited and Participating Utilities

Region B		
Utilities Invited	**Accepted**	**Declined**
Wichita Falls	X	

Table B-3. Region C Invited and Participating Utilities

Region C		
Utilities Invited	**Accepted**	**Declined**
Addison	X	
Allen	X	
Arlington	X	
Athens		X
Azle		X
Balch Springs	X	
Bedford		X
Bonham	X	
Carrollton	X	
Cedar Hill	X	
Celina		X
Cockrell Hill	X	
Colleyville	X	
Copeville SUD	X	
Coppell	X	
Corinth	X	
Corsicana	X	

Region C		
Utilities Invited	**Accepted**	**Declined**
Crowley	X	
Dallas	X	
De Soto	X	
Denton	X	
Denton County FWSD	X	
Duncanville	X	
East Cedar Creek FWSD		X
East Fork SUD	X	
Ennis		X
Euless	X	
Farmers Branch	X	
Farmersville		X
Flower Mound		X
Forest Hill		X
Forney	X	
Fort Worth	X	
Frisco	X	
Garland	X	
Glenn Heights		X
Grand Prairie	X	
Grapevine	X	
Haltom City	X	
Highland Park	X	
Highland Village	X	
Honey Grove		X
Hurst	X	
Hutchins		X
Irving	X	
Kaufman	X	
Keller	X	
Krum		X
Lancaster	X	
Lewisville		X
Little Elm	X	
Mabank	X	
Mansfield		X
McKinney	X	
Mesquite	X	
Midlothian	X	

Region C		
Utilities Invited	**Accepted**	**Declined**
Mountain Peak SUD	X	
Murphy		X
Mustang SUD		X
North Richland Hills	X	
Plano	X	
Richardson	X	
Richland Hills		X
Roanoke		X
Rockett SUD		X
Rockwall	X	
Rowlett		X
Royse City		X
Sachse	X	
Saginaw	X	
Sanger		X
Sardis-Lone ELM WSC	X	
Seagoville	X	
Seis Lagos UD		X
Sherman	X	
Southlake	X	
Springtown	X	
Terrell	X	
The Colony	X	
Tioga	X	
Tom Bean		X
Trophy Club	X	
University Park	X	
Van Alstyne	X	
Watauga	X	
Weatherford	X	
West Cedar Creek MUD		X
White Settlement		X
Wylie	X	
Wortham	X	

Table B-4. Region D Invited and Participating Utilities

Region D		
Utilities Invited	**Accepted**	**Declined**
Texarkana	X	

Table B-5. Region E Invited and Participating Utilities

Region E		
Utilities Invited	**Accepted**	**Declined**
Horizon Regional MUD	X	
Lower Valley Water District		X
El Paso	X	

Table B-6. Region F Invited and Participating Utilities

Region F		
Utilities Invited	**Accepted**	**Declined**
Andrews	X	
Ballinger	X	
Big Spring		X
Brady	X	
Bronte		X
Coleman	X	
Junction	X	
Menard		X
Midland	X	
Odessa	X	
Robert Lee		X
San Angelo	X	
Snyder	X	
Winters	X	

Table B-7. Region G Invited and Participating Utilities

Region G		
Utilities Invited	**Accepted**	**Declined**
Abilene	X	
Bethesda WSC	X	
Brenham	X	
Brushy Creek MUD	X	
Bryan	X	
Burleson	X	
Cedar Park	X	
Chisholm Trail SUD	X	
College Station	X	
Georgetown	X	
Groesbeck	X	
Hewitt	X	
Kempner WSC	X	
Lampasas	X	
Leander	X	
Possum Kingdom WSC	X	
Round Rock	X	
Robinson	X	
Sweetwater	X	
Temple	X	
Waco	X	
Woodway	X	

Table B-8. Region H Invited and Participating Utilities

Region H		
Utilities Invited	**Accepted**	**Declined**
Arcola		X
Baytown	X	
Bellaire		X
Central Harris County Regional WA		X
Clute	X	
Conroe	X	
Dickinson	X	
Deer Park	X	
Friendswood	X	
Ft. Bend County Mud #23		X

Region H		
Utilities Invited	**Accepted**	**Declined**
Ft. Bend County Mud #25		X
Galveston	X	
Harris County Mud #148 - Kingslake		X
Harris County Mud #46		X
Harris County Mud #49		X
Houston	X	
Humble	X	
Huntsville	X	
Jersey Village	X	
Katy	X	
Lake Jackson	X	
La Marque		X
League City	X	
New Caney MUD		X
North Channel Water Authority		X
North Ft. Bend Water Authority		X
North Harris County Regional WA		X
Northwest Park MUD		X
Oak Ridge North		X
Pasadena	X	
Pearland	X	
Porter SUD		X
Rayford Road MUD		X
Southern Montgomery County MUD	X	
Spring Creek UD		X
Sugar Land	X	
Sunbelt FWSD		X
Tomball		X
Willis	X	
West Harris County Regional WA		X
West University Place	X	
Woodlands	X	

Table B-9. Region I Invited and Participating Utilities

Region I		
Utilities Invited	**Accepted**	**Declined**
Beaumont		X
Nacogdoches		X
Lufkin		X

Table B-10. Region J Invited and Participating Utilities

Region J		
Utilities Invited	**Accepted**	**Declined**
Del Rio	X	
Kerrville	X	

Table B-11. Region K Invited and Participating Utilities

Region K		
Utilities Invited	**Accepted**	**Declined**
Austin	X	
Aqua WSC	X	
Bastrop		X
Goldthwaite		X
Horseshoe Bay	X	
Johnson City	X	
Llano	X	
Pflugerville	X	
Travis County WCID #10		X
Travis County WCID #17	X	
West Travis County Public Utility Agency	X	

Table B-12. Region L Invited and Participating Utilities

Region L		
Utilities Invited	**Accepted**	**Declined**
Alamo Heights	X	
Atascosa Rural WSC	X	
Canyon Lake WSC		X
Converse		X
Crystal Clear WSC	X	
Hondo	X	
Karnes City		X
Kyle		X
Lockhart		X
New Braunfels	X	
Sabinal	X	
San Antonio Water System	X	
San Marcos	X	
Universal City	X	
Uvalde	X	
Victoria	X	

Table B-13. Region M Invited and Participating Utilities

Region M		
Utilities Invited	**Accepted**	**Declined**
Agua SUD	X	
Alamo		X
Alton		X
East Rio Hondo WSC	X	
Edcouch		X
Edinburg	X	
Elsa		X
Hidalgo		X
Hidalgo County MUD #1	X	
Laredo	X	
La Feria		X
La Villa		X
McAllen	X	
Mercedes		X
Military Highway WSC		X
Mission	X	
North Alamo WSC	X	
Olmito WSC	X	
Pharr	X	
Rio Grande City		X
San Juan	X	
Sharyland WSC	X	
Union WSC	X	
Weslaco	X	
Zapata County Waterworks	X	

Table B-14. Region N Invited and Participating Utilities

Region N		
Utilities Invited	**Accepted**	**Declined**
Corpus Christi	X	
Nueces County WCID #3	X	

Table B-15. Region O Invited and Participating Utilities

Region O		
Utilities Invited	**Accepted**	**Declined**
Brownfield	X	
Dimmit		X
Lamesa	X	
Levelland	X	
Lubbock	X	
Seminole	X	
Shallowater		X
Silverton	X	
Tahoka		X

Table C-16. Region P Invited and Participating Utilities

Region P		
Utilities Invited	**Accepted**	**Declined**
El Campo	X	

Table C-17. Summary Invited and Participating Utilities

Summary		
Utilities Invited	**Accepted**	**Declined**
TOTAL	**167**	**78**

Intentionally Left Blank

Appendix C – Texas Water Development Board Official Comments

M E M O R A N D U M

TO: ROBERT MACE

THRU: Kevin Kluge
John Sutton

FROM: Phyllis Thomas

DATE: August 31, 2017

RE: Research Contract with Averitt and Associates; Contract No. 1600012030, Draft Report Comments

DRAFT REPORT RECEIVED: July 18, 2017

Enclosed is the draft report comment letter.

Please forward to Robert E. Mace for his signature.

Thank you.

The Honorable Kip Averitt
Averitt and Associates, Inc.
1212 Guadalupe Street, Suite 301
Austin, TX 78701

RE: Research Contract with Averitt and Associates, Inc., Contract No. 1600012030, Draft Report Comments

Dear Mr. Averitt:

Staff members of the Texas Water Development Board (TWDB) have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT 1 provides the comments resulting from this review. As stated in the TWDB contract, Averitt and Associates, Inc. (Averitt) will consider revising the final report in response to comments from the Executive Administrator and other reviewers. In addition, Averitt will include a copy of the Executive Administrator's draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. **Please further note, that in compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report must comply with the requirements and standards specified in statute. For more information, visit http://www.sos.state.tx.us/tac/index.shtml.** If you have any questions on accessibility, please contact David Carter with the Contract Administration Division at (512) 936-6079 or David.Carter@twdb.texas.gov.

Averitt shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

Please feel free to contact Mr. John Sutton of our Conservation staff at (512) 463-7988 or john.sutton@twdb.texas.gov if you have any questions or need any further information.

Sincerely,

Robert E. Mace, Ph.D., P.G. Date: ________________
Deputy Executive Administrator
Water Science and Conservation

Attachment

c w/o att.: Mr. John Sutton, Conservation

Attachment 1
Averitt and Associates, Inc.
Contract No. 1600012030
TWDB Comments to Draft Report

General Report

1. Report should read as one report, needs cover page and a table of contents.
2. Considering having an executive summary separate from the reports that describes the study, approach, etc.
3. Appendix numbering needs to be corrected.
4. The statewide report provides more in depth discussion on methodological assumptions and limitations that would be extremely beneficial to include in the RWPG and utility reports (e.g. page 9, 2nd paragraph discussion).
5. Do not round numbers. All numbers in the report text and in the footnotes should be exact.
6. Some paragraphs are spaced inconsistently with the report. IE. 6.2.2.
7. Participating Utility lists are inconsistently formatted. Some are alphabetized down-to-right and others right-to-down.
8. Many double spaces after periods in every report. Too many to list.
9. Colored columns currently serve no consistent purpose. Either color group them with related data, or make them all the same color.
10. Initial use of acronym is spelled out. Acronym should not be defined more than once (and it was, e.g. GPCD) in the short reports.
11. The "TWDB" logo/label should be removed from all pages and only a clearly worded reference to TWDB as the funding agency in response to a legislative rider should be included at the beginning of each report.
12. Methodology section of state regional and entity summaries and sources of data references and explanations is inadequate. The methodological description, including data sources, must be sufficiently detailed to allow others to replicate the study and the findings/conclusions/results. Methodology should, in clearly detail and explain what data was collected, how it was collected, how it was used to draw conclusions aimed at achieving the goals of the study.
13. The stated study goals in the state report do not match the stated study goals in the regional reports.
14. Throughout all reports, clarify whether "acre-feet" should, instead, be "acre-feet per year".
15. Reports do not adequately summarize the key assumptions used throughout the study or the technical/methodological limitations regarding the uncertainties and difficulties in attempting to quantifiably measure conservation savings that may have already been achieved.

STATE REPORT

16. Page 1, section 1.1 – describe the process of engagement. 230 utilities were targeted, only 170 participated.
17. Show the list of all participating utilities.
    - Page 2, section 1.2 – need to rework bullets 6, 6 and 8. Concerned about aggregating the activity savings vs. WMS volumes and declaring everything

fine. Potentially some big conservers can push the water-saved numbers up and it looks like plenty of water is being conserved. The problem may still exist on a regional or local level. If the volumes saved and WMS volumes are aggregated, then the state and regional reports should list the number of participating utilities that do not reach the near and long-term WMS volumes.

- Page 2, section 1.2 – last bullet – Not clear on this statement. Be clear if the 2020 Mun Cons WMS strategy volume or the 2020 Existing Supply volume is used. Similar to above, a surplus in one utility does not negate a shortage in another. SWP states 203,757 AFY in 2020 for Municipal Conservation.

18. Page 2, section 1.3, second paragraph – Need to elaborate on "The state should potentially develop a process to standardize and improve provider-level water use data and conservation savings estimates". Consider deleting the first sentence. Explain what is a robust database of water usage and how much more robust might the state be.
19. Page 2, section 1.3, last paragraph – not sure of citing BBC, 2012.
20. Page 3, section 2, first paragraph – cite should be TWDB.
    - Cite the 16 regional water plans.
    - Last sentence - Most of this sentence is a direct quote starting with "in addition", so needs to be in quotation marks and cited.
21. Page 3, section 2, second paragraph – cite source of 811,000 acre/feet and the state water plan.
22. Section 2, Paragraph 3, 3rd sentence – "Accomplishing our municipal conservation goals is critical to continuing to entice the best and brightest employers and employees to the state – and to keeping them here." This is beyond a factual statement for a report branded from TWDB.
23. Page 3, section 2, fourth paragraph – Please explain the source of these numbers, seem to be high. Also add the cost of conservation WMS. This figure includes the cost of reservoirs. See table on page 99 of 2017 SWP.
24. Page 3, section 2, last paragraph – replace" are being" to "will be".
25. Section 2.1, first paragraph, 2nd sentence – "... (Region I did not participate)…" should be rephrased as "identified utilities in Region I did not participate". Please describe outreach and communication efforts to Region I and what reason they declined. Please accurately reflect that the Region I RWPG was not asked to directly participate in the study.
26. Page 4, section 2.1 – delete second bullet.
27. Page 4, section 2.1, third bullet – replace "conservation goals" with "water management strategies".
28. Page 4, section 3 – cite TWDB.
29. Page 5, section 3.1, first bullet – Note if all targeted reductions follow this formula or not. Only region L is cited. Identify all RWPGs or none specifically that don't recommend further reductions after 140 gpcd.
    - Last paragraph – Cite the regions.
    - Avoid use of such adjectives as "venerable" in a report branded from TWDB.
30. Section 4, Table 2-1 – Suggest adding column of "Number of Invited Utilities" to illustrate opportunity provided to Region I.

31. Page 9, section 6.2, second paragraph – statement made in the last sentence needs to include considerations for other factors such as wet year, economics, etc.
32. Page 10, section 6.2.1 – add underlined subtitle's for each conservation activity that was utilized in this study.
    - Third paragraph – need complete citation for EPA; AWWA.
    - Fourth paragraph, first bullet – need to provide the stated model
        - Should at least acknowledge that price increases may not always result in continued, long-term water savings as many studies have shown that after the initial savings from increases that people revert to original use habits. Geographic location and income levels can also have an impact on whether rate increases will reduce usage levels.
        - Last sub-bullet – add citation
33. Page 11, section 6.2.2, first paragraph – need to cite the 2012 TWDB Quantitation Study
    - Indent entire block quote
34. Page 11, section 6.2.2, third paragraph – typo *there* was occasionally.
35. Page 12, section 7, first paragraph – need to cite 2017 State Water Plan. 811,000 acre-feet does not seem correct.
    - Fourth paragraph – no Table 5-1 as noted.
36. Page 17, Table 7-5 – Would be helpful to note the total number of utilities this is based on.
37. Page 18 – best not to use terms or brand names such as WaterWise or WISE Guys. Conservation Kits and Irrigation Evaluations are more appropriate for utilities not using those particular programs.
38. Page 18, last paragraph – spell out PCS.
39. Page 19, Table 8-1 – text needs to describe when and why certain conservation activities end.
40. Page 20, first paragraph – delete Far and away…
    - Second paragraph – delete undoubtedly.
    - Last paragraph should read - Forty-five of the 170 participating utilities have adopted ordinances limiting outdoor watering to twice per week and are projected to save 107,654 acre-feet in 2020. That savings estimate is 59 percent of the entire state's 2020 supply volume of 182,799 acre-feet.
41. Page 20, section 9, #2 – delete Instead.
    - Last bullet – need complete citation
    - Last sentence - delete or explain the last sentence – Of course...
42. Page 22, second paragraph – Cite TWDB 2012 Quantification Report. Be sure of complete title and use it consistently throughout the report.
    - Section 10, fourth bullet – This recommendation is unclear; explain or delete if not needed.

REGIONAL REPORTS
General

43. Section 1, second paragraph - Do not believe these were the primary goals. The scope of work has the primary goals as 1. Developing an approach to estimate the implementation of recommended strategies, 2. Assess and quantitatively determine the implementation of those strategies, and 3. Incorporate use of BMPs to meet needs.
    - Section 1.1 does not appear to describe study objectives but rather includes some disparate information and describes some tasks. For example, the first sentence refers to "first objective" but does not describe what the first objective is.
44. Section 1.2, first paragraph – need to cite State Water Plan.
45. Section 2, first paragraph, similar notes as in the state plan. Concerned about aggregating all of the numbers and then declaring success. List the number of participating utilities that will meet their 2040/2070 WMS volumes and those that will not. "Xx of the 63 utilities are not expected to achieve the WMS volumes in 2070; the average shortfall is estimated to be x,xxx."
    - There appears to be no basis provided for the Result (page 3) that Region D will be "short by 5,226 acre-feet".
    - There appears to be no numerical or methodological basis provided for the statement "The non-participating utilities of the region must achieve 148 acre-feet [sic] of WMS supply volume for municipal conservation by the end of the planning period."
46. Section 2.1, second paragraph – Need to cite plan.
    - Quote needs to be blocked and indented.
47. Section 2.1 - Please clarify the calculation of "utility population" from the 2016 regional water plans. The population projections in these plans were based upon city boundaries, not utility service areas. Sometimes these populations align in the 2016 RWPs but generally they do not (ex: DWU vs. City of Dallas). Utility service area planning will be the basis for the 2021 RWPs/2022 SWP so representation of "utility populations" from the 2016 RWPs/2017 SWP is misleading and causes confusion for the reader. If the planning groups consider the information in this report during the development of their 2021 RWP, could be unnecessarily confusing.
48. Recommend further or more robust discussion of what the "over/short" methodologies are, what the results are meant to convey, and what the limitations of the analysis are. As currently presented it is difficult to understand for the general reader and oversimplifies "over" and "short". On face value, "short" can be interpreted by the general reader as "failure to conserve" without an understanding of the limitations of the analysis or challenges to measure and achieve conservation savings on an annual basis due to a variety of factors.
49. Page 3, last paragraph - The report states that this report "should not be considered a final report". Delete this sentence entirely as it misstates to readers that, in fact, it will actually be a "final report".
50. Section 4 - Do not mention specific third-party programs by name.

51. The report states that the "Disparity Table[s]" for each utility show "how much of the change in the GPCD is due to quantifiable water conservation activities and water loss control efforts and how much from other factors" but does not acknowledge the overarching issue of the difficulty of isolating and measuring conservation in light of the many variables that impact GPCD including weather, the economy, socioeconomic factors and other variables that are not addressed in these studies. This comment also applies to the first two paragraphs on page 8.
52. Page 3, Conclusions section - Reports do not provide a clear methodological or numerical basis for the conclusions. Delete conclusions or provide detailed methodology and numerical basis for conclusions presented.
53. Page 4: descriptor headers in text to not match table headers. For example, "Utility Population" does not match the first field in Table 3-1. Correct either report text or table header naming to align.
    - The methodological and sources of numbers for the summary numbers presented in Table 3-1 are not specifically clear. Provide methodological information for the basis of the table numbers, including the year basis for each, that is in sufficient detail for others to confirm or to replicate the Table. Recommend also including description of how data from different years was used and compared.
    - The purposes and differences of the two tables, 3-1 and 3-2 are unclear in the report. Please clarify the differences and significance of the two tables.
54. Page 8, third paragraph - lists how conservation activities were quantified but does not provide any details about the numerous methodologies listed including with numbers in Table 4-1. Provide detailed methodology sufficient to replicate study results associated with each of the quantification methods listed and all numbers presented in Table 4-1.
55. Page 10 - the key assumption that "savings grow with demand" is not substantiated in the report and does not appear reasonable in light of the fact that increased demands do not necessarily translate to conservation savings especially in instances where new demand comes online at a starting lower GPCD, for example, due to new building construction etc. Please revise report accordingly.
56. Page 12 - Report does not appear to provide any factual basis for the statement "These activities are all projected to be cost effective." Provide basis for statement or delete sentence entirely.
57. Page 12, Last paragraph - The report does not appear to provide any factual basis for the conservation practices recommended for Region D. Provide basis for statement or delete sentence entirely.
58. Section 7.3 - overemphasizes the PACE program. Reduce discussion of PACE program and include more balanced discussion of other training and financing opportunities in report section.
59. Resources like AWE, the Saveteaaswater site, the best management practices, water efficiency network trainings and AWWA would be good things to include as resource options.

Region A

- Several numbers in the report are off by ±3 acre-feet per year.
- Table 3-2 differs from footnote #1.

Region C

- Denton County FWSD listed in report, but we have WUGs for #1A, #7, and #10. Only reviewed the planning data for #1A as this was the only one found on the Participating Utility Contacts list. Add the "#1A" to the name in the regional report or clarify which utilities are being used.
- Table 3-2 differs from footnote #1.

Region D

- Page 3, second to last paragraph, first sentence - The statement: "The WMS supply volume for Texarkana is particularly high." is vague and has no apparently basis in the report. Strike sentence in its entirety. Entire paragraph is difficult to understand. Rewrite remainder of paragraph.

Region E

- El Paso has roughly 1,000 acre-feet per year, which is about half, of their municipal conservation supply drop off in 2040. The report ignored this statistic.

Region H

- Huntsville is listed as a participating utility; however, it does not have any recommended WMS strategy supplies assigned to it, nor is it called out in the text as being individually invited. Thus, it seems to lack the criteria to "identify municipal conservation as a WMS in their regional water plans within the first two decades of the planning period."

Region K

- Similar issue with naming as C. Might suggest to name "Travis County" to "Travis County WCID No. 17" or clarify which utilities are being used.

Region L

- Atascosa Rural WSC's municipal conservation WMS does not take effect until 2070; therefore, does not meet the first two decade criteria.
- Table 3-1 - The water loss reduction shown as zero is confusing. SAWS perhaps did not understand that this was going to be represented in this way. SAWS has had water loss control efforts since before 2015, but this would lead a reader to think no utility in Region L was ever working on the issue.
    - Year 16 shows changes in the data. Any reduction in savings should be explained. If the conclusion was that SAWS intended to stop conservation that needs to be cleared up. SAWS' last plan may have accidentally given that impression as it only showed targets out to certain date.
- Table 3-2 - Finding this confusing. Seems to be actual data up until a certain date. Show how is the unaccounted for conservation volume is calculated. Be clear if

there are targets in Region L showing reductions and not a plan for achieving them.

- Section 4, Quantified Savings - It seems questionable to call out the WaterWise brand name for the kits. Instead show that retrofit kits were provided by either in house efforts or through a third party vendor. The program savings assumes 100 percent installation of the kits. The updated REUS study unfortunately was unable to discern significant savings from replaced showerheads and aerators. It's unclear why as in theory it should save. But replacement programs like this should include some caveats as those just learning will assume savings will be as advertised by vendor.
- Section 4, Quantified Savings - It is concerning to call out Save Water Co. as a specific strategy. This company is not active in Region L (at least not in San Antonio). Having them listed in an official report appears to endorse them and could lead to confusion, Instead perhaps list having in house or third party programs that identify and repair leaks and replace high flow fixtures.
- Section 4, Quantified Savings - WISE Guys is a great third party contractor. But it is concerning to call them out specifically in an official TWDB report. It would seem more logical to have it categorized as Third Party Irrigation Evaluation. The current language seems to imply that WISE Guys is the only endorsed way to do this. Local utilities could hire licensed irrigators to do this type of service.
- Section 6-2 – This heading and text do not seem to go together. The statement needs further explanation and backup data. Residential for small towns may be lower than more urban large communities because there may be less discretionary usage. This report was not intended to analyze this, but it would be worth noting that this is a complex issue needing further analysis. There may still be significant water savings options for small towns, but the options may be different than for other areas with different consumption patterns.

Region M

- Similar issue with naming as in Region C - Hidalgo County MUD #1.

Region P

- A prime example of Participating Utility Population matching the report when 'WugEntityPrimaryRegion' is used, but does not match with 'WugSplitRegion'.

UTILITY REPORTS

General Comments

60. Page 2: remove the use of "your" throughout report.
61. Reports do not appear logical as it appears to indirectly mix multiple, poorly labeled GPCDs "reported GPCD" "recent GPCD" – one GPCD used in the regional plan that was the basis for the WMS strategy that is also referenced in the table and at least one other GPCD that is associated with conservation reports and that will almost certainly be different than the value used in the regional water plan since the plan is a different GPCD basis for a different circumstance of drought of record. In instances where the drought of record GPCD is low, it is likely and easily predictable, without

any study, that every entity will appear to not be meeting their planned WMS conservation since one would be comparing a default low-GPCD with a wetter year GPCD. Address this issue in the report by modifying methodology.

62. The fundamental report methodology appears flawed in that is mixing conditions such as inaccurately referring to "WMS Volume as GPCD Reduction" using a resulting GPCD under non-drought conditions which will inevitably result in the appearance of not meeting a target since the DOR condition which may have a higher or lower water use and GPCD depending on the relative weather conditions on which the conservation plan reporting is based and the historic year that was selected for water planning purposes.

63. Report methodology appears fundamentally flawed in that it is making inappropriate comparisons between total water use as well as recent GPCDs reported in utility conservation plans and entirely different, and GPCDs and WMSs that are in the regional water plan and that are selected and utilized for a different purpose, that being drought of record water planning conditions in which there is often significantly different water use depending on the dry year condition selected for planning.

64. It is unclear what comparisons are being made in the tables and report. For example, it is unclear on page 1 what "their quantified savings" are and how and where they were calculated.

65. Section 1, first paragraph, first sentence – Add the complete agency name to the citation.
    - Need to cite regional water plans

66. Section 1.1 Methodology –
    - Need to cite first sentence.
    - Add to end of first paragraph - It should be noted that in comparing information from the regional water planning process, from the conservation plans and the water loss audits, and from the utility itself, some slight inconsistencies may occur. As an example, municipal water user groups that are incorporated cities in the 2017 State Water Plan have population and water demand projections limited to their city limits while information in the conservation plan, water loss audit, and from the utility itself pertains to the utility's entire service area, regardless of city limits. Report authors have attempted to minimize such discrepancies, but the nature of the planning process and various reports dictate that current efforts to quantify conservation efforts in relation to the conservation water management strategies must accept possible discrepancies at this point.
    - Third paragraph – Cite Dallas conservation plan.

67. Page 2, paragraph 3: Report does not explain the methodology used to quantify "activity savings."

68. Page 2, fourth paragraph: Sentence is unclear and the critical methodology or numerical basis that was used to arrive at "their quantified savings from activities dating back to 2012" is not presented in the report.

69. Page 2, second to last paragraph: the report does not explain the very critical and difficult step of how the contractor "quantified savings from activities dating back five years from the utility's most recent water conservation plan on file with the

TWDB." Explain, in detail, how this was performed and describe in detail the numerous limitations associated with attempting to making such estimates considering the difficulty of isolating and measuring conservation in light of the many variables that impact GPCD including weather, the economy, socioeconomic factors and other variables that are not addressed in these studies and that, based on the information provided, was not addressed in any fashion in the technical methods used by the contractor.

70. Chapters 2, Footnote 5 – the limitations presented in this footnote are significant. Recommend they be placed in the text of the report rather than as a footnote.

71. Chapter 2, Footnote 6 – Recommend identifying directly in the utility reports if the base year deviates from 2011.

72. Section 2.2, Actual Water Loss Reduction Savings (as of 2015) - Do not use the GPCD term to avoid confusion if the end result is a MG volume.
    - This definition should read: The difference between a baseline per-person per-day water loss and the most recent per-person per-day water loss value reported in the 2015 water loss audit on file with TWDB and then converted to a million gallons (MG) per year volume. The summary of these savings can be referenced in Table 4 -2.

73. Section 2.2, Conservation WMS Volume – cite regional plan.

74. Section 2.3, first paragraph, last sentence - As noted earlier, this can be a misleading comparison, comparing a dry-year (2011) RWP GPCD to a wet-year (2015) GPCD. The report must address this comparison. If the 2015 RWP GPCD is used, as posted on the TWDB website (197 for Dallas), the dry-year, wet-year comparison still needs to be noted.
    - For most entities, this should result in a large positive disparity: going from a dry-year use to a wet-year use should result in a large decrease that is not explained by conservation activities. In Dallas's case, the reduction in GPCD should have been greater, but there must have been a latent increase in per-person water use.

75. Section 2.3, Total GPCD - should read as: Year Zero in this column is the utility's baseline RWP GPCD consumption. The utility's most recently reported current Total GPCD value is carried forward in the subsequent years. Any increases or decreases to GPCD in those years would affect the savings listed in the "Annual Savings with Reduction in GPCD (MG)" and the "Difference" columns.
    - Cite source of this GPCD.
    - Again concerned this compares the 2011 RWP GPCD with a 2015 Total GPCD (from conservation plan annual report).

76. Table 2-3, Disparity column - Don't understand the assumption that the 2015 GPCD would be carried forward in to the future; GPCD values jump all over the place. Consider an analysis between the baseline RWP GPCD and the 2015 RPW GPCD, reducing the table to 2 rows: Baseline and 2015.

77. Section 2.4, Table 2-4 - The description of the column headings should be clearly stated as in sections 2.1 – 2.3, even if that means repeating the same information again.

78. Section 2.5, Table 2-5 - The description of the column headings should be clearly stated as in sections 2.1 – 2.3, even if that means repeating the same information again.
79. Section 2.5 – The basis for numbers developed in entire section is not clear. Provided specific sources of data and make clearer what was reported from Dallas vs what was calculated and where assumptions came from.
80. Section 2.5, fourth paragraph - is somewhat confusing, please clarify.
81. Section 2.5, fifth paragraph - Avoid using the GPCD term unless necessary. Consider removing the per-person values if they are simply going to be converted to MG volumes.
82. Section 3.1.1, AMI system – need to rethink this savings based on each utility's use.
83. Section 3.1.2, Twice a week watering – Citation, be clear if this is the Hermitte and Mace report. If so, should state that. If not, you do not have a different report referenced on the reference sheet for Hermitte.
    - Cite Sierra Club-Lone Star Chapter and the National Wildlife Federation
84. Section 5 - Data sources and methodology behind Figure 5-1 is unclear. The figure appears to present several GPCDs but only labels one line as "GPCD". It is unclear as to what "WMS volume" represents or how that was calculated.
85. Figure 5-1: What appears to be presented as a 'trend line' in Figure 5-1 is too short to draw conclusions as suggested in the paragraph above the figure. Simple, short-term GPCD trend lines are not actually a reliable indicator of conservation achievements without further analysis since there are many factors that affect GPCD and the data used to calculate GPCD and on which the trend lines are based. Please modify description in report to acknowledge that estimating/evaluating conservation savings that have actually been achieved is extremely difficult and impacted by many variables impacting GPCD.
86. Section 6, Suggested Activities – Recommendations need to have an explanation on why the utility should consider this activity and how those savings were calculated.
87. Section 7 - Should only include references for those cited in the text of each report.
    - Spell out all abbreviations.
    - Alphabetize list.
    - When the same author, use same initials. Also, should mention that the references should be the same throughout, so if using initials stay with initials, but if using full name, use full name for all.
88. Remove comments like "Keep up the good work".

Brushy Creek Municipal District

89. It reads that by 2070 the RWP expects Brushy Creek to reduce volume by 669 MG through conservation strategies. This does not seem possible since the total volume in 2016 was 940 MG and the district will not be any bigger in 2070 than now.

City Of Dallas

90. Clarify if this should be the City of Dallas or Dallas Water Utility in heading, text and citations.
91. Report is difficult to follow and understand. For example, the statement in the second paragraph on page 7: "Table 2-3 shows the disparity between all current

quantified activities and the savings represented by the decline from your utility's 2011 baseline total GPCD in the regional water plan and currently reported GPCD levels." Talks about a single "disparity" (presented in Table 2-3) but refers to three different numbers that confuse the reader. And, again, the reference and comparison between current GPCD and the drought of record GPCD for the purposes of quantifying a "disparity" is inappropriate since the basis for the two GPCDs are different and could likely and predictably bias the analysis throughout.

92. No basis is provided for recommending rainwater harvesting on page 19. Strike recommendation.
93. Page 19: strike bullet #4.

City of Sweetwater

94. It is unclear if these suggestions are tailored to Sweetwater (each utility) or are universal suggestions for all utilities.
95. Explain how are the quantified savings are derived. Explain the metrics used to measure quantified savings and if the metrics are standardized between utilities.
96. Explain how the quantified savings are derived and if it is from a statewide compilation or from what utilities have reported on their annual reports. Explain if there is a standardized methodology required for use by each utility to measure quantified savings. If not, then the tendency will be for utilities to over-report quantified savings and the comparison of actual savings by each utility will come up short when compared to projected savings.

Intentionally Left Blank

Appendix D - Regional Reports

Statewide Municipal Water Conservation Quantification Project
Report to the Panhandle Water Planning Group
Region A • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region A make up approximately 275,000 in population by 2020, which is 66 percent of the region's total projected 2020 population.
- Participating utilities make up 61 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of six participating water utilities in place—and without further enhancement—Region A as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 1,151 acre-feet per year.
- With the current conservation activities of six participating water utilities in place—and without further enhancement—these utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 278 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 585 acre-feet per year.
- Of those utilities surveyed, the region averages 2.3 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies (WMS) that can be used to meet the needs identified throughout the 50-year planning period.

Region A is a 21-county region encompassing the upper Panhandle of Texas. It is a sparsely populated, agricultural region in which municipal conservation plays a relatively smaller role than in other regions.

The Region A Plan states, "[w]ater conservation is a valued water management strategy in the Panhandle Water Planning Group (PWPG) because it helps prolong the limited water resources in the region." The plan calls for 5,429 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this water management strategy supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.
[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region A are 3,690 acre-feet per year for 2020, 4,022 acre-feet per year for 2030, 4,333 acre-feet per year for 2040, 4,675 acre-feet per year for 2050, and 5,044 acre-feet per year for 2060.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region A, seven utilities met these criteria and were contacted for participation. Six utilities accepted and were included in the results:

Amarillo	Dalhart
Borger	Dumas
Canyon	Perryton

These utilities represent approximately 66 percent of the 2020 population of Region A and represent 61 percent of the 2020 WMS supply volume for municipal water conservation for the region.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

The PWPG considered the following criteria when recommending conservation strategies to WUGs within the region:

- Cost
- Potential Water Savings
- Time to Implement
- Public Acceptance
- Technical Feasibility
- Staff Resources

Published reports and previous studies were used to estimate savings of water conservation BMPs. It was noted by the planners that water savings from some BMPs were difficult to estimate because there is little supporting data available for them (Texas Water Development Board, 2016).

Region A planners selected these strategies (activities) for utilities in Region A:

- Education and Outreach – assumed savings would be 2 percent of total water demand
- Water Audits and Leak Repair – assumed 20 percent of entities' losses could be recovered

- Rate Structure – assumed that 10 percent of households would save 6,000 gallons annually
- Landscape Ordinance – assumed savings of 1,000 gallons per increased number of households annually for utilities over 20,000 population
- Time of Day Watering Limit – assumed that 75 percent of the population would realize 1,000 gallons/household per year for utilities over 20,000 population
- Water Waste Ordinance – assumed savings of 3,000 gallons/household/year for 75 percent of households.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region A. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region A.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
A	6	5	0	0	0	0	1	1	0	1	0	14	2.3

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region A is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water rate increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). The project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings quantified by the utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated plumbing code savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.
Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility’s service area are implemented on a micro-scale is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting its Municipal Conservation Supply Volumes?

The 2016 Region A Water Plan recommends that Region A should achieve 5,429 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the six utilities surveyed in this region are estimated to exceed their portion (3,534 acre-feet per year) by 585 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 1,895 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the six participating utilities. These utilities constitute approximately 66 percent of the region's population and account for 61 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	761	1,287	2,047	1,005	0	1,005	1,042
2016	1,111	1,300	2,410	1,256	0	1,256	1,154
2017	1,151	1,313	2,464	1,256	0	1,256	1,207
2018	1,163	1,326	2,489	1,508	0	1,508	981
2019	1,175	1,340	2,515	1,759	0	1,759	755
2020	1,187	1,353	2,540	2,262	0	2,262	278
2021	1,199	1,369	2,568	2,287	0	2,287	281
2022	1,211	1,386	2,596	2,312	0	2,312	284
2023	1,223	1,402	2,625	2,337	0	2,337	288
2024	1,235	1,418	2,653	2,362	0	2,362	291
2025	1,247	1,434	2,681	2,387	0	2,387	294
2026	1,258	1,450	2,709	2,413	0	2,413	296
2027	1,271	1,466	2,737	2,438	0	2,438	299
2028	1,283	1,483	2,765	2,463	0	2,463	302
2029	1,295	1,499	2,793	2,488	0	2,488	305
2030	1,307	1,515	2,822	2,512	0	2,512	309
2031	1,320	1,531	2,852	2,537	0	2,537	315
2032	1,333	1,548	2,881	2,560	0	2,560	321
2033	1,347	1,564	2,911	2,583	0	2,583	328
2034	1,360	1,581	2,941	2,607	0	2,607	334
2035	1,373	1,597	2,970	2,630	0	2,630	340
2036	1,386	1,613	3,000	2,653	0	2,653	347
2037	1,400	1,630	3,029	2,677	0	2,677	353
2038	1,413	1,646	3,059	2,700	0	2,700	359
2039	1,426	1,663	3,089	2,723	0	2,723	365
2040	1,439	1,679	3,118	2,744	0	2,744	371
2041	1,453	1,696	3,149	2,771	0	2,771	378
2042	1,467	1,712	3,180	2,795	0	2,795	385
2043	1,481	1,729	3,210	2,819	0	2,819	391
2044	1,496	1,745	3,241	2,843	0	2,843	398
2045	1,510	1,762	3,272	2,867	0	2,867	404
2046	1,524	1,778	3,302	2,892	0	2,892	411
2047	1,538	1,795	3,333	2,916	0	2,916	417
2048	1,552	1,812	3,364	2,940	0	2,940	424
2049	1,566	1,828	3,394	2,964	0	2,964	430
2050	1,580	1,845	3,425	2,986	0	2,986	437
2051	1,596	1,863	3,459	3,015	0	3,015	444
2052	1,612	1,881	3,493	3,042	0	3,042	451
2053	1,627	1,900	3,527	3,069	0	3,069	458
2054	1,643	1,918	3,561	3,096	0	3,096	465
2055	1,658	1,936	3,595	3,122	0	3,122	472
2056	1,674	1,955	3,628	3,149	0	3,149	479
2057	1,689	1,973	3,662	3,176	0	3,176	486
2058	1,705	1,991	3,696	3,203	0	3,203	493
2059	1,721	2,010	3,730	3,230	0	3,230	500
2060	1,736	2,028	3,764	3,255	0	3,255	507
2061	1,752	2,047	3,800	3,285	0	3,285	515
2062	1,769	2,067	3,835	3,313	0	3,313	523
2063	1,785	2,086	3,871	3,340	0	3,340	531
2064	1,801	2,106	3,907	3,368	0	3,368	538
2065	1,817	2,125	3,942	3,396	0	3,396	546
2066	1,833	2,145	3,978	3,424	0	3,424	554
2067	1,850	2,164	4,014	3,452	0	3,452	562
2068	1,866	2,183	4,049	3,479	0	3,479	570
2069	1,882	2,203	4,085	3,507	0	3,507	578
2070	1,898	2,222	4,120	3,534	0	3,534	585

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
A	Meeting	4	985	4	1,079	4	1,206	4	1,335	4	1,468	4	1,614
	Not Meeting	2	(707)	2	(770)	2	(835)	2	(898)	2	(961)	2	(1,029)
	Total Region A	6	278	6	309	6	371	6	437	6	507	6	585

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volume for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	761	1,287	2,047	1,640	407
2016	1,111	1,300	2,410	2,051	360
2017	1,151	1,313	2,464	2,051	413
2018	1,163	1,326	2,489	2,461	28
2019	1,175	1,340	2,515	2,871	(356)
2020	1,187	1,353	2,540	3,691	(1,151)
2021	1,199	1,369	2,568	3,724	(1,156)
2022	1,211	1,386	2,596	3,757	(1,161)
2023	1,223	1,402	2,625	3,790	(1,166)
2024	1,235	1,418	2,653	3,823	(1,170)
2025	1,247	1,434	2,681	3,857	(1,175)
2026	1,258	1,450	2,709	3,890	(1,181)
2027	1,271	1,466	2,737	3,923	(1,186)
2028	1,283	1,483	2,765	3,956	(1,191)
2029	1,295	1,499	2,793	3,989	(1,195)
2030	1,307	1,515	2,822	4,022	(1,200)
2031	1,320	1,531	2,852	4,053	(1,201)
2032	1,333	1,548	2,881	4,084	(1,202)
2033	1,347	1,564	2,911	4,114	(1,204)
2034	1,360	1,581	2,941	4,145	(1,205)
2035	1,373	1,597	2,970	4,176	(1,206)
2036	1,386	1,613	3,000	4,207	(1,207)
2037	1,400	1,630	3,029	4,238	(1,208)
2038	1,413	1,646	3,059	4,268	(1,209)
2039	1,426	1,663	3,089	4,299	(1,210)
2040	1,439	1,679	3,118	4,330	(1,212)
2041	1,453	1,696	3,149	4,364	(1,215)
2042	1,467	1,712	3,180	4,399	(1,219)
2043	1,481	1,729	3,210	4,433	(1,223)
2044	1,496	1,745	3,241	4,467	(1,226)
2045	1,510	1,762	3,272	4,502	(1,230)
2046	1,524	1,778	3,302	4,536	(1,234)
2047	1,538	1,795	3,333	4,570	(1,237)
2048	1,552	1,812	3,364	4,604	(1,241)
2049	1,566	1,828	3,394	4,639	(1,244)
2050	1,580	1,845	3,425	4,673	(1,248)
2051	1,596	1,863	3,459	4,710	(1,251)
2052	1,612	1,881	3,493	4,747	(1,255)
2053	1,627	1,900	3,527	4,785	(1,258)
2054	1,643	1,918	3,561	4,822	(1,261)
2055	1,658	1,936	3,595	4,859	(1,264)
2056	1,674	1,955	3,628	4,896	(1,268)
2057	1,689	1,973	3,662	4,933	(1,271)
2058	1,705	1,991	3,696	4,971	(1,274)
2059	1,721	2,010	3,730	5,008	(1,278)
2060	1,736	2,028	3,764	5,045	(1,281)
2061	1,752	2,047	3,800	5,083	(1,284)
2062	1,769	2,067	3,835	5,122	(1,286)
2063	1,785	2,086	3,871	5,160	(1,289)
2064	1,801	2,106	3,907	5,199	(1,292)
2065	1,817	2,125	3,942	5,237	(1,295)
2066	1,833	2,145	3,978	5,275	(1,297)
2067	1,850	2,164	4,014	5,314	(1,300)
2068	1,866	2,183	4,049	5,352	(1,303)
2069	1,882	2,203	4,085	5,391	(1,306)
2070	1,898	2,222	4,120	5,429	(1,309)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

---

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	1,288	755									5		2,047
2016	1,300	1,095						9	1		6		2,410
2017	1,312	1,135						9	1		6		2,464
2018	1,327	1,148						9	1		6		2,489
2019	1,339	1,160						9	1		6		2,515
2020	1,355	1,172						9	1		6		2,540
2021	1,369	1,184						9	1		6		2,568
2022	1,387	1,196						9	1		6		2,596
2023	1,402	1,208						9	1		6		2,625
2024	1,419	1,220						9	1		6		2,653
2025	1,434	1,232						9	1		6		2,681
2026	1,452	1,244						9			6		2,709
2027	1,466	1,256						9			6		2,737
2028	1,484	1,268						9			6		2,765
2029	1,499	1,280						9			6		2,793
2030	1,517	1,292						9			6		2,822
2031	1,532	1,306						9			6		2,852
2032	1,547	1,319						9			6		2,881
2033	1,565	1,332						9			6		2,911
2034	1,580	1,345						9			6		2,941
2035	1,598	1,359						9			6		2,970
2036	1,613	1,372						9			6		3,000
2037	1,631	1,385						9			6		3,029
2038	1,646	1,398						9			6		3,059
2039	1,664	1,412						9			6		3,089
2040	1,679	1,425						9			6		3,118
2041	1,697	1,439						9			6		3,149
2042	1,712	1,453						9			6		3,180
2043	1,728	1,467						9			6		3,210
2044	1,746	1,481						9			6		3,241
2045	1,761	1,495						9			6		3,272
2046	1,780	1,509						9			6		3,302
2047	1,795	1,523						9			6		3,333
2048	1,810	1,538						9			6		3,364
2049	1,829	1,552						9			6		3,394
2050	1,844	1,566						9			6		3,425
2051	1,864	1,581						9			6		3,459
2052	1,881	1,597						9			6		3,493
2053	1,898	1,613						9			6		3,527
2054	1,919	1,628						9			6		3,561
2055	1,936	1,644						9			6		3,595
2056	1,956	1,659						9			6		3,628
2057	1,973	1,675						9			6		3,662
2058	1,990	1,691						9			6		3,696
2059	2,011	1,706						9			6		3,730
2060	2,028	1,722						9			6		3,764
2061	2,046	1,738						9			6		3,800
2062	2,068	1,754						9			6		3,835
2063	2,086	1,770						9			6		3,871
2064	2,105	1,786						9			6		3,907
2065	2,126	1,803						9			6		3,942
2066	2,145	1,819						9			6		3,978
2067	2,163	1,835						9			6		4,014
2068	2,185	1,851						9			6		4,049
2069	2,203	1,867						9			6		4,085
2070	2,221	1,884						9			6		4,120

9 Region A Challenges

Listed below are challenges the PWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt. Traditional conservation activities, therefore, are not seen as particularly necessary.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the PWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The PWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The PWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential for further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in the region are considering AMI systems. AMI systems are a popular and growing activity throughout the state. They represent a new way of informing consumers about their consumption patterns and can be a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and PWPG could help those communities take advantage of new technology. Meters must be replaced over time and AMI systems could help many municipalities reduce staff overhead along with their water-savings benefits. Perhaps the PWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs. Note that SWIFT funding is only available for projects that are recommended in a utility's regional water plan.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region A, the most common suggested activities were to install AMI to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org
http://www.savetexaswater.org/bmp/

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the B Water Planning Group • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- The participating utility in Region B makes up approximately 107,000 in population by 2020, which is 52 percent of the region's total projected 2020 population.
- The participating utilities make up 90 percent of the region's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of the participating water utility in place—and without further enhancement—Region B as a whole is projected

to exceed its recommended 2020 water conservation supply volume by 473 acre-feet per year.

- These conservation savings estimates will fall short of the region's 2059 supply volume by 21 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of the participating water utility in place—and without further enhancement—this utility is projected to exceed its recommended 2020 water conservation supply volume by 961 acre-feet per year.[1]
- Without further activity, this utility is projected to exceed its 2070 supply volume by 1,362 acre-feet per year.
- The participating utility employs four measurable conservation activities to achieve these results.

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region B is comprised of ten entire counties and a portion of one county in north central Texas. In general, most of the population is concentrated in eastern portions of the region with over one-half located in and around Wichita Falls. The City of Wichita Falls is the largest water demand center in the region. The region is generally arid and not a rapid growth area of the state.

The Region B Plan states, "[w]ater conservation is a valued water management strategy in Region B because it helps extend the water resources in the region. It is recommended for all municipal and irrigation water users, whether the user has a defined shortage or not." The plan calls for 6,098 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016a). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this water management supply volume for municipal water conservation.

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region B are 4,972 acre-feet per year for 2020, 5,160 acre-feet per year for 2030, 5,182 acre-feet per year for 2040, 5,446 acre-feet per year for 2050, and 5,810 acre-feet for 2060 per year.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region B, no utilities met these criteria; however, it was important to include Region B in the statewide research project. Wichita Falls agreed to participate.

Wichita Falls represents approximately 52 percent of the 2020 population of Region B and 90 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Wichita Falls received a report on the results of its water conservation activities and water loss efforts and is included as a part of this report. This report summarizes the savings from the individual utility report within Region B.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing

- Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

The regional planners noted the work of the Water Conservation Task Force. They believe however, that regional planning groups should be allowed to establish goals for the region only after "…sufficient data on water use have been collected using consistent data reporting requirements."

The Region B Water Planning Group (RBWPG) recommended these municipal conservation strategies:

- Leak Detection, Repair and Pipeline Replacement – assumed to save 2,242 acre-feet per year by 2070
- Public Education Programs
- Water Waste Ordinance (permanent time-of-day and day-of-week restrictions for outdoor watering)
- Landscape Ordinance requiring low-water use landscapes for new residential construction

The last three strategies (activities) are expected to save an additional 2,242 acre-feet per year by the end of the planning period. Savings estimates are based on what other North Texas communities are saving, and upon savings achieved by El Paso, Austin, and San Antonio. Also, it was assumed that water systems with per capita demand over 100 gallons per capita per day (GPCD) could save 10 percent through advanced conservation and utilities with under 100 GPCD could save five percent through the end of the planning period.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the City of Wichita Falls. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region B.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
B	1	1	1	0	0	0	0	0	0	0	1	4	4.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately to ensure Region B is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare GPCD consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections

for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may

create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Region B Water Plan recommends that Region B should achieve 6,098 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that Wichita Falls is estimated to exceed its portion (4,484 acre-feet per year) by 1,362 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 1,614 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region’s participating utility’s quantified savings estimates are progressing toward meeting its 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the one participating utility. This utility constitutes approximately 52 percent of the region’s population and account for 90 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	3,290	1,915	5,205	1,993	0	1,993	3,212
2016	3,292	1,919	5,211	2,491	0	2,491	2,720
2017	3,506	1,922	5,428	2,491	0	2,491	2,937
2018	3,508	1,925	5,434	2,989	0	2,989	2,444
2019	3,511	1,929	5,440	3,488	0	3,488	1,952
2020	3,513	1,932	5,445	4,484	0	4,484	961
2021	3,515	1,939	5,455	4,484	0	4,484	971
2022	3,518	1,946	5,464	4,484	0	4,484	980
2023	3,520	1,953	5,474	4,484	0	4,484	990
2024	3,523	1,961	5,483	4,484	0	4,484	999
2025	3,525	1,968	5,492	4,484	0	4,484	1,008
2026	3,527	1,975	5,502	4,484	0	4,484	1,018
2027	3,530	1,982	5,511	4,484	0	4,484	1,027
2028	3,532	1,989	5,521	4,484	0	4,484	1,037
2029	3,534	1,996	5,530	4,484	0	4,484	1,046
2030	3,537	2,003	5,540	4,484	0	4,484	1,056
2031	3,538	2,008	5,546	4,484	0	4,484	1,062
2032	3,540	2,014	5,553	4,484	0	4,484	1,069
2033	3,541	2,019	5,560	4,484	0	4,484	1,076
2034	3,542	2,025	5,567	4,484	0	4,484	1,083
2035	3,544	2,030	5,574	4,484	0	4,484	1,090
2036	3,545	2,036	5,581	4,484	0	4,484	1,097
2037	3,547	2,041	5,588	4,484	0	4,484	1,104
2038	3,548	2,047	5,595	4,484	0	4,484	1,111
2039	3,549	2,053	5,602	4,484	0	4,484	1,118
2040	3,551	2,058	5,609	4,484	0	4,484	1,125
2041	3,553	2,062	5,615	4,484	0	4,484	1,131
2042	3,555	2,066	5,621	4,484	0	4,484	1,137
2043	3,557	2,070	5,627	4,484	0	4,484	1,143
2044	3,560	2,074	5,633	4,484	0	4,484	1,149
2045	3,562	2,077	5,639	4,484	0	4,484	1,155
2046	3,564	2,081	5,645	4,484	0	4,484	1,161
2047	3,566	2,085	5,651	4,484	0	4,484	1,167
2048	3,568	2,089	5,657	4,484	0	4,484	1,173
2049	3,571	2,093	5,664	4,484	0	4,484	1,180
2050	3,573	2,097	5,670	4,484	0	4,484	1,186
2051	3,578	2,101	5,679	4,484	0	4,484	1,195
2052	3,584	2,104	5,688	4,484	0	4,484	1,204
2053	3,589	2,108	5,697	4,484	0	4,484	1,213
2054	3,595	2,112	5,706	4,484	0	4,484	1,222
2055	3,600	2,115	5,715	4,484	0	4,484	1,231
2056	3,606	2,119	5,725	4,484	0	4,484	1,241
2057	3,611	2,123	5,734	4,484	0	4,484	1,250
2058	3,616	2,126	5,743	4,484	0	4,484	1,259
2059	3,622	2,130	5,752	4,484	0	4,484	1,268
2060	3,627	2,134	5,761	4,484	0	4,484	1,277
2061	3,633	2,137	5,770	4,484	0	4,484	1,286
2062	3,638	2,140	5,778	4,484	0	4,484	1,294
2063	3,643	2,143	5,787	4,484	0	4,484	1,303
2064	3,649	2,146	5,795	4,484	0	4,484	1,311
2065	3,654	2,150	5,804	4,484	0	4,484	1,320
2066	3,659	2,153	5,812	4,484	0	4,484	1,328
2067	3,665	2,156	5,820	4,484	0	4,484	1,336
2068	3,670	2,159	5,829	4,484	0	4,484	1,345
2069	3,675	2,162	5,837	4,484	0	4,484	1,353
2070	3,680	2,165	5,846	4,484	0	4,484	1,362

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole. As there is only one participating utility in this region, the table shows Wichita Falls' decadal surpluses.

Table 7-2. Participating Utilities Estimated To Be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
B	Meeting	1	961	1	1,056	1	1,125	1	1,186	1	1,277	1	1,362
	Not Meeting		0		0		0		0		0		0
	Total Region B	1	961	1	1,056	1	1,125	1	1,186	1	1,277	1	1,362

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volume for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	3,290	1,915	5,205	2,210	2,996
2016	3,292	1,919	5,211	2,762	2,449
2017	3,506	1,922	5,428	2,762	2,666
2018	3,508	1,925	5,434	3,315	2,119
2019	3,511	1,929	5,440	3,867	1,573
2020	3,513	1,932	5,445	4,972	473
2021	3,515	1,939	5,455	4,991	464
2022	3,518	1,946	5,464	5,010	455
2023	3,520	1,953	5,474	5,028	445
2024	3,523	1,961	5,483	5,047	436
2025	3,525	1,968	5,492	5,066	426
2026	3,527	1,975	5,502	5,085	417
2027	3,530	1,982	5,511	5,104	408
2028	3,532	1,989	5,521	5,122	398
2029	3,534	1,996	5,530	5,141	389
2030	3,537	2,003	5,540	5,160	380
2031	3,538	2,008	5,546	5,162	384
2032	3,540	2,014	5,553	5,164	389
2033	3,541	2,019	5,560	5,167	394
2034	3,542	2,025	5,567	5,169	399
2035	3,544	2,030	5,574	5,171	403
2036	3,545	2,036	5,581	5,173	408
2037	3,547	2,041	5,588	5,175	413
2038	3,548	2,047	5,595	5,178	417
2039	3,549	2,053	5,602	5,180	422
2040	3,551	2,058	5,609	5,182	427
2041	3,553	2,062	5,615	5,208	407
2042	3,555	2,066	5,621	5,235	386
2043	3,557	2,070	5,627	5,261	366
2044	3,560	2,074	5,633	5,288	346
2045	3,562	2,077	5,639	5,314	325
2046	3,564	2,081	5,645	5,340	305
2047	3,566	2,085	5,651	5,367	285
2048	3,568	2,089	5,657	5,393	264
2049	3,571	2,093	5,664	5,420	244
2050	3,573	2,097	5,670	5,446	224
2051	3,578	2,101	5,679	5,482	196
2052	3,584	2,104	5,688	5,519	169
2053	3,589	2,108	5,697	5,555	142
2054	3,595	2,112	5,706	5,592	115
2055	3,600	2,115	5,715	5,628	87
2056	3,606	2,119	5,725	5,664	60
2057	3,611	2,123	5,734	5,701	33
2058	3,616	2,126	5,743	5,737	6
2059	3,622	2,130	5,752	5,774	(21)
2060	3,627	2,134	5,761	5,810	(49)
2061	3,633	2,137	5,770	5,839	(69)
2062	3,638	2,140	5,778	5,868	(89)
2063	3,643	2,143	5,787	5,896	(110)
2064	3,649	2,146	5,795	5,925	(130)
2065	3,654	2,150	5,804	5,954	(150)
2066	3,659	2,153	5,812	5,983	(171)
2067	3,665	2,156	5,820	6,012	(191)
2068	3,670	2,159	5,829	6,040	(211)
2069	3,675	2,162	5,837	6,069	(232)
2070	3,680	2,165	5,846	6,098	(252)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2010													
2011													
2012													
2013													
2014		1,832											1,832
2015	1,915	1,834	1,457										5,205
2016	1,919	1,835	1,458										5,211
2017	1,922	1,836	1,459		211								5,428
2018	1,925	1,837	1,459		211								5,434
2019	1,929	1,839	1,460		212								5,440
2020	1,932	1,840	1,461		212								5,445
2021	1,939	1,841	1,462		212								5,455
2022	1,946	1,842	1,463		212								5,464
2023	1,953	1,844	1,464		212								5,474
2024	1,961	1,845	1,465		212								5,483
2025	1,968	1,846	1,466		212								5,492
2026	1,975	1,847	1,467		213								5,502
2027	1,982	1,849	1,468		213								5,511
2028	1,989	1,850	1,469		213								5,521
2029	1,996	1,851	1,470		213								5,530
2030	2,003	1,852	1,471		213								5,540
2031	2,008	1,853	1,472		213								5,546
2032	2,014	1,854	1,472		213								5,553
2033	2,019	1,854	1,473		213								5,560
2034	2,025	1,855	1,474		214								5,567
2035	2,030	1,856	1,474		214								5,574
2036	2,036	1,857	1,475		214								5,581
2037	2,041	1,857	1,475		214								5,588
2038	2,047	1,858	1,476		214								5,595
2039	2,053	1,859	1,477		214								5,602
2040	2,058	1,860	1,477		214								5,609
2041	2,062	1,861	1,478		214								5,615
2042	2,066	1,862	1,479		214								5,621
2043	2,070	1,863	1,480		214								5,627
2044	2,074	1,864	1,481		215								5,633
2045	2,077	1,865	1,482		215								5,639
2046	2,081	1,867	1,483		215								5,645
2047	2,085	1,868	1,484		215								5,651
2048	2,089	1,869	1,484		215								5,657
2049	2,093	1,870	1,485		215								5,664
2050	2,097	1,871	1,486		215								5,670
2051	2,101	1,874	1,489		216								5,679
2052	2,104	1,877	1,491		216								5,688
2053	2,108	1,880	1,493		216								5,697
2054	2,112	1,883	1,495		217								5,706
2055	2,115	1,885	1,498		217								5,715
2056	2,119	1,888	1,500		217								5,725
2057	2,123	1,891	1,502		218								5,734
2058	2,126	1,894	1,504		218								5,743
2059	2,130	1,897	1,507		218								5,752
2060	2,134	1,900	1,509		219								5,761
2061	2,137	1,903	1,511		219								5,770
2062	2,140	1,905	1,513		219								5,778
2063	2,143	1,908	1,516		220								5,787
2064	2,146	1,911	1,518		220								5,795
2065	2,150	1,914	1,520		220								5,804
2066	2,153	1,916	1,522		221								5,812
2067	2,156	1,919	1,524		221								5,820
2068	2,159	1,922	1,527		221								5,829
2069	2,162	1,925	1,529		222								5,837
2070	2,165	1,928	1,531		222								5,846

9 Region B Challenges

Listed below are challenges the RBWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Regarding the smaller towns in Region B that did not participate, their success in meeting WMS supply volume will depend on their understanding of the need for, and value of, municipal conservation. They should understand their part in the region's WMS supply volume objectives.

Educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives would encourage them to work toward achieving reasonable results.

9.3 State Prisons

State prisons are a large user of water. However, they are not always required to adhere to drought restrictions or conservation measures. This issue came to light during the 2011 drought when Wichita Falls was desperate for water.

10 Recommendations

Listed below are recommendations for the RBWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The RBWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The RBWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities around the state are considering Advanced Metering Infrastructure (AMI). AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and RBWPG could help those communities take advantage of new technology. Meters must be replaced over time and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the RBWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would allow for the calculation of savings and cost estimates for Wichita Falls.

Regarding Region B, Wichita Falls should continue to expand its use of AMI with the customer portal that is has recently deployed.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Region C Water Planning Group • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region C make up approximately 6,100,000 in population by 2020, which is 81 percent of the region's total projected 2020 population.
- Participating utilities make up 90 percent of the region's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of 63 participating water utilities in place—and without further enhancement—Region C as a whole is projected

to exceed its recommended 2020 water conservation supply volume by 65,432acre-feet per year.

- With the current conservation activities of 63 participating water utilities in place—and without further enhancement—these utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 70,994 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 75,846 acre-feet per year.
- Of those utilities surveyed, the region averages 3.4 per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region C covers all or part of 16 North Central Texas counties. As of the 2010 census, the population of Region C represents 25 percent of Texas' total population. Region C is heavily urbanized, with 83 percent of the population located in cities with populations in excess of 20,000 people. Region C is a rapidly growing part of the state.

The Region C Plan states, "[c]ities and utilities in Region C have made significant strides in the implementation of water conservation efforts. It is important that suppliers in the region build on this momentum with continued conservation efforts." The plan calls for 131,056 acre-feet per year of savings to come from municipal water conservation by 2070.[2] Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.
[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region C are 55,628 acre-feet per year for 2020, 88,259 acre-feet per year for 2030, 97,327 acre-feet per year for 2040, 109,091 acre-feet per year for 2050, and 120,028 acre-feet per year for 2060.

interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region C, 89 utilities met these criteria and were contacted for participation. Out of the 89, 63 utilities accepted and were included in the results:

Addison	Denton Cty. FWSD #1A	Irving	Sardis-Lone Elm
Allen	Desoto	Kaufman	Seagoville
Arlington	Duncanville	Keller	Sherman
Balch Springs	East Fork SUD	Lancaster	Southlake
Bonham	Euless	Little Elm	Springtown
Carrollton	Farmers Branch	Mabank	Terrell
Cedar Hill	Forney	McKinney	The Colony
Cockrell Hill	Fort Worth	Mesquite	Tioga
Colleyville	Frisco	Midlothian	Trophy Club
Copeville SUD	Garland	Mountain Peak SUD	University Park
Coppell	Grand Prairie	North Richland Hills	Van Alstyne
Corinth	Grapevine	Plano	Watauga
Corsicana	Haltom City	Richardson	Weatherford
Crowley	Highland Park	Rockwall	Wortham
Dallas	Highland Village	Sachse	Wylie
Denton	Hurst	Saginaw	

These utilities represent about 82 percent of the 2020 population of Region C and represent 90.1 percent of the 2020 WMS supply volume for municipal water conservation for the region.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

In deriving recommended conservation strategies for Region C, the Region C Water Planning Group (RCWPG) considered cost, potential waste savings, and the prospects of implementation. They also took into account current implementation levels.

Recommendations are for implementation by each water user group in the region and include:

- Enhanced Education – savings were estimated to be two percent by 2070
- Rate Structures – savings were estimated to be two percent by 2070
- Enhanced water loss control – savings were projected to be .05 percent by 2020
    - Audits
    - Active leak detection and repair
    - Pressure control
    - Water main replacement
    - AMR technology
- Time of Day Irrigation Restrictions – savings were assumed to be 2.9 percent of seasonal water demands for customers with automatic irrigation systems, and

- Water Waste Prohibition – savings were estimated to be 3.3 percent of irrigation water use for accounts with automatic irrigation systems.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region C. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities Of Participating Utilities (Since 2011) In Region C.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
C	63	49	31	3	6	3	14	3	5	6	30	213	3.4

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How conservation activity be measured accurately to ensure Region B is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to simply compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).
[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by The Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed uniform savings estimates used throughout the project for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (Pcs)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility’s service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Region C Water Plan recommends that Region C should achieve 131,056 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the 63 utilities surveyed in this region are estimated to exceed their portion (105,568 acre-feet per year) by 75,846 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 25,488 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 63 participating utilities. These utilities constitute approximately 82 percent of the region's population and account for 90.1 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from all Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in Acre-Feet Per Year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	80,840	18,700	99,540	11,566	10,685	22,252	77,289
2016	95,085	19,101	114,186	14,458	13,357	27,815	86,371
2017	98,150	19,395	117,545	14,458	16,028	30,486	87,058
2018	99,014	19,689	118,703	17,350	18,699	36,049	82,654
2019	99,831	19,984	119,814	20,241	21,371	41,612	78,202
2020	100,781	20,279	121,060	26,024	24,042	50,067	70,994
2021	101,777	20,707	122,484	28,658	24,275	52,933	69,551
2022	102,825	21,135	123,960	31,291	24,508	55,799	68,160
2023	103,534	21,563	125,097	33,925	24,741	58,666	66,431
2024	104,241	21,985	126,226	36,558	24,974	61,532	64,693
2025	104,954	22,407	127,361	39,192	25,207	64,399	62,962
2026	105,672	22,829	128,501	41,825	25,440	67,265	61,236
2027	106,736	23,251	129,987	44,459	25,673	70,132	59,856
2028	107,803	23,673	131,477	47,092	25,906	72,998	58,478
2029	108,867	24,095	132,963	49,725	26,139	75,865	57,098
2030	109,935	24,517	134,452	52,359	26,373	78,732	55,720
2031	111,268	24,812	136,080	54,711	24,915	79,626	56,454
2032	112,607	25,106	137,713	57,063	23,457	80,521	57,193
2033	113,940	25,401	139,341	59,416	22,000	81,415	57,925
2034	115,272	25,699	140,971	61,768	20,542	82,310	58,661
2035	116,608	25,996	142,604	64,120	19,084	83,205	59,400
2036	117,944	26,294	144,238	66,472	17,627	84,099	60,139
2037	119,277	26,591	145,868	68,825	16,169	84,994	60,874
2038	120,613	26,889	147,502	71,177	14,711	85,888	61,613
2039	121,949	27,186	149,135	73,529	13,254	86,783	62,352
2040	123,282	27,484	150,765	75,881	11,796	87,677	63,088
2041	124,291	27,620	151,911	76,931	11,521	88,452	63,459
2042	125,294	27,756	153,050	77,981	11,245	89,226	63,824
2043	126,303	27,892	154,195	79,031	10,970	90,000	64,195
2044	127,306	28,034	155,340	80,080	10,694	90,774	64,565
2045	128,315	28,176	156,491	81,130	10,419	91,549	64,942
2046	129,318	28,317	157,635	82,180	10,143	92,323	65,312
2047	130,324	28,459	158,783	83,230	9,868	93,097	65,686
2048	131,330	28,601	159,931	84,279	9,592	93,871	66,059
2049	132,336	28,743	161,078	85,329	9,317	94,646	66,434
2050	133,342	28,884	162,226	86,379	9,041	95,420	66,807
2051	134,081	29,149	163,230	87,201	8,796	95,996	67,234
2052	134,824	29,414	164,238	88,023	8,550	96,573	67,665
2053	135,566	29,679	165,245	88,845	8,305	97,150	68,095
2054	136,305	29,944	166,249	89,667	8,059	97,726	68,523
2055	137,048	30,209	167,257	90,488	7,814	98,303	68,955
2056	137,787	30,475	168,262	91,310	7,569	98,879	69,383
2057	138,527	30,740	169,266	92,132	7,323	99,456	69,811
2058	139,272	31,005	170,277	92,954	7,078	100,032	70,245
2059	140,011	31,270	171,282	93,776	6,832	100,609	70,673
2060	140,754	31,536	172,289	94,598	6,587	101,185	71,104
2061	141,352	31,847	173,200	95,356	6,268	101,623	71,576
2062	141,951	32,159	174,110	96,114	5,948	102,062	72,048
2063	142,549	32,471	175,020	96,871	5,629	102,500	72,520
2064	143,145	32,786	175,931	97,629	5,309	102,938	72,992
2065	143,743	33,101	176,844	98,387	4,990	103,377	73,467
2066	144,342	33,416	177,757	99,145	4,670	103,815	73,942
2067	144,943	33,731	178,674	99,903	4,351	104,253	74,421
2068	145,542	34,045	179,587	100,661	4,031	104,692	74,896
2069	146,140	34,360	180,501	101,418	3,712	105,130	75,371
2070	146,739	34,675	181,414	102,176	3,392	105,568	75,846

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
C	Meeting	52	72,947	50	58,509	47	68,854	45	74,606	42	78,587	43	84,588
	Not Meeting	11	(1,953)	13	(2,789)	16	(5,766)	18	(7,789)	21	(7,483)	20	(8,742)
	Total Region C	63	70,994	63	55,720	63	63,088	63	66,807	63	71,104	63	75,846

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Total Regional WMS Volume</u> – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

<u>Unaccounted for Conservation WMS Volume</u> – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	80,840	18,700	99,540	24,724	74,817
2016	95,085	19,101	114,186	30,904	83,281
2017	98,150	19,395	117,545	30,904	86,640
2018	99,014	19,689	118,703	37,085	81,618
2019	99,831	19,984	119,814	43,266	76,548
2020	100,781	20,279	121,060	55,628	65,432
2021	101,777	20,707	122,484	58,891	63,593
2022	102,825	21,135	123,960	62,154	61,806
2023	103,534	21,563	125,097	65,417	59,680
2024	104,241	21,985	126,226	68,680	57,546
2025	104,954	22,407	127,361	71,944	55,417
2026	105,672	22,829	128,501	75,207	53,295
2027	106,736	23,251	129,987	78,470	51,518
2028	107,803	23,673	131,477	81,733	49,744
2029	108,867	24,095	132,963	84,996	47,967
2030	109,935	24,517	134,452	88,259	46,193
2031	111,268	24,812	136,080	89,166	46,914
2032	112,607	25,106	137,713	90,073	47,641
2033	113,940	25,401	139,341	90,979	48,361
2034	115,272	25,699	140,971	91,886	49,085
2035	116,608	25,996	142,604	92,793	49,811
2036	117,944	26,294	144,238	93,700	50,538
2037	119,277	26,591	145,868	94,607	51,262
2038	120,613	26,889	147,502	95,513	51,988
2039	121,949	27,186	149,135	96,420	52,715
2040	123,282	27,484	150,765	97,327	53,438
2041	124,291	27,620	151,911	98,584	53,327
2042	125,294	27,756	153,050	99,842	53,208
2043	126,303	27,892	154,195	101,099	53,096
2044	127,306	28,034	155,340	102,357	52,983
2045	128,315	28,176	156,491	103,614	52,877
2046	129,318	28,317	157,635	104,871	52,764
2047	130,324	28,459	158,783	106,129	52,654
2048	131,330	28,601	159,931	107,386	52,545
2049	132,336	28,743	161,078	108,644	52,435
2050	133,342	28,884	162,226	109,901	52,325
2051	134,081	29,149	163,230	110,914	52,317
2052	134,824	29,414	164,238	111,926	52,311
2053	135,566	29,679	165,245	112,939	52,306
2054	136,305	29,944	166,249	113,952	52,298
2055	137,048	30,209	167,257	114,965	52,293
2056	137,787	30,475	168,262	115,977	52,284
2057	138,527	30,740	169,266	116,990	52,276
2058	139,272	31,005	170,277	118,003	52,274
2059	140,011	31,270	171,282	119,015	52,266
2060	140,754	31,536	172,289	120,028	52,261
2061	141,352	31,847	173,200	121,131	52,069
2062	141,951	32,159	174,110	122,234	51,876
2063	142,549	32,471	175,020	123,336	51,684
2064	143,145	32,786	175,931	124,439	51,491
2065	143,743	33,101	176,844	125,542	51,302
2066	144,342	33,416	177,757	126,645	51,113
2067	144,943	33,731	178,674	127,748	50,926
2068	145,542	34,045	179,587	128,850	50,737
2069	146,140	34,360	180,501	129,953	50,547
2070	146,739	34,675	181,414	131,056	50,358

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (In Acre-Feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rain Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	18,702	9,314	65,566	335	274	241	7	618	5	46	2,633	1,787	99,543
2016	19,099	21,403	66,557	336	277	261	7	1,081	5	49	2,950	2,141	114,182
2017	19,393	22,989	67,420	338	1,167	183	5	1,081	5	34	2,951	1,964	117,542
2018	19,687	23,182	68,283	340	1,174	113	3	1,081	5	21	2,952	1,852	118,701
2019	19,982	23,378	69,147	341	1,181	58	1	1,081	5	11	2,953	1,670	119,814
2020	20,279	23,568	70,010	343	1,188	20		1,081	5	3	2,953	1,607	121,061
2021	20,706	23,765	70,874	345	1,195	1		1,081	5		2,953	1,556	122,481
2022	21,133	23,958	71,737	346	1,202			1,081	4		2,953	1,545	123,960
2023	21,563	24,151	72,600	348	1,209			1,081	4		2,953	1,187	125,097
2024	21,984	24,341	73,464	350	1,217			1,081	2		2,953	836	126,227
2025	22,408	24,531	74,327	352	1,224			1,081	1		2,953	482	127,361
2026	22,829	24,730	75,190	353	1,231			1,081			2,953	132	128,503
2027	23,253	24,920	76,054	355	1,238			1,081			2,953	133	129,988
2028	23,674	25,116	76,917	357	1,245			1,081			2,953	134	131,479
2029	24,099	25,306	77,781	358	1,252			1,081			2,953	134	132,964
2030	24,520	25,502	78,644	360	1,259			1,081			2,953	135	134,454
2031	24,816	25,735	79,737	361	1,262			1,081			2,953	135	136,081
2032	25,106	25,982	80,830	362	1,266			1,081			2,953	136	137,715
2033	25,399	26,214	81,923	364	1,269			1,081			2,953	136	139,341
2034	25,698	26,445	83,016	365	1,272			1,081			2,953	137	140,970
2035	25,994	26,686	84,109	366	1,276			1,081			2,953	138	142,601
2036	26,293	26,924	85,201	367	1,279			1,081			2,953	138	144,239
2037	26,589	27,159	86,294	368	1,282			1,081			2,953	139	145,868
2038	26,888	27,397	87,387	369	1,286			1,081			2,953	139	147,499
2039	27,187	27,635	88,480	370	1,289			1,081			2,953	140	149,137
2040	27,483	27,870	89,573	372	1,293			1,081			2,953	140	150,766
2041	27,621	28,077	90,371	373	1,296			1,081			2,953	141	151,911
2042	27,756	28,277	91,169	375	1,299			1,081			2,953	142	153,050
2043	27,891	28,481	91,967	376	1,303			1,081			2,953	142	154,195
2044	28,038	28,681	92,765	377	1,306			1,081			2,953	143	155,342
2045	28,175	28,884	93,563	379	1,309			1,081			2,953	143	156,489
2046	28,316	29,088	94,362	380	1,312			1,081			2,953	144	157,637
2047	28,457	29,291	95,160	382	1,316			1,081			2,953	145	158,784
2048	28,601	29,492	95,958	383	1,319			1,081			2,953	145	159,932
2049	28,742	29,695	96,756	385	1,322			1,081			2,953	146	161,079
2050	28,886	29,899	97,554	386	1,326			1,081			2,953	146	162,229
2051	29,148	30,054	98,133	388	1,326			1,081			2,953	147	163,231
2052	29,414	30,212	98,712	389	1,326			1,081			2,953	147	164,238
2053	29,680	30,373	99,292	391	1,326			1,081			2,953	148	165,245
2054	29,943	30,534	99,871	393	1,326			1,081			2,953	149	166,253
2055	30,207	30,695	100,450	394	1,326			1,081			2,953	149	167,258
2056	30,474	30,850	101,030	396	1,327			1,081			2,953	150	168,263
2057	30,738	31,008	101,609	398	1,327			1,081			2,953	150	169,267
2058	31,002	31,172	102,188	399	1,327			1,081			2,953	151	170,275
2059	31,269	31,330	102,768	401	1,327			1,081			2,953	151	171,280
2060	31,532	31,489	103,347	402	1,327			1,081			2,953	152	172,288
2061	31,846	31,612	103,821	403	1,327			1,081			2,953	153	173,199
2062	32,157	31,738	104,296	404	1,327			1,081			2,953	153	174,110
2063	32,471	31,862	104,770	404	1,327			1,081			2,953	154	175,022
2064	32,785	31,982	105,245	405	1,327			1,081			2,953	154	175,933
2065	33,097	32,102	105,719	406	1,327			1,081			2,953	155	176,844
2066	33,414	32,225	106,194	406	1,328			1,081			2,953	155	177,759
2067	33,726	32,352	106,668	407	1,328			1,081			2,953	156	178,673
2068	34,044	32,475	107,142	408	1,328			1,081			2,953	157	179,587
2069	34,358	32,598	107,617	408	1,328			1,081			2,953	157	180,502
2070	34,675	32,719	108,091	409	1,328			1,081			2,953	158	181,413

9 Region C Challenges

Listed below are challenges the RCWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that many utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in smaller towns throughout Texas is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in small and medium-sized towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the RCWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The RCWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The RCWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar future data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Region C are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and RCWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the RCWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region C, the most commonly suggested activities were to install AMI with a customer portal to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption. Rain barrels would be also effective in some parts of the region. And although Region C has a high incidence of twice-a-week watering ordinances, there is still plenty of opportunity to save significant amounts of water through wider adoption of this activity.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the North East Texas Regional Water Planning Group
Region D • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- The participating utility in Region D makes up approximately 37,000 in population by 2020, which is five percent of the region's total projected 2020 population.
- The participating utility makes up 99 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of the participating water utility in place—and without further enhancement—Region D as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 4,976 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2070 supply volume by 5,374 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of the participating water utility in place—and without further enhancement—this utility is projected to fall short of its recommended 2020 water conservation supply volume by 4945 acre-feet per year.[1]
- Without further activity, this utility is projected to fall short of its 2070 volume by 5,226 acre-feet per year.
- The participating utility employs two measurable conservation activities to achieve these results.

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region D is made up of all or part of 19 counties in North East Texas. The North East Texas Region is largely rural. Most towns within the region have populations of less than 10,000 people and there are many small, unincorporated areas within counties. Region D is not a rapid-growth area of the state.

The plan calls for 6,876 acre-feet per year of savings to come from municipal water conservation by 2070 [2] (Texas Water Development Board, 2016c). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

It is important to note that the WMS supply volume for Texarkana is particularly high. Per the Region D water plan:

> "For each water user group with a shortage and consumption greater than 140 gallons per capita per day (GPCD), a water conservation strategy was considered.... After

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region D are 6,434 acre-feet per year for 2020, 6,717 acre-feet per year for 2030, 6,884 acre-feet per year for 2040, 6,836 acre-feet per year for 2050, and 6,848 acre-feet per year for 2060.

evaluation, the advanced water conservation scenario was only considered as an applicable strategy for a single municipality, the City of Texarkana, whereby savings of up to approximately 6,815 [sic][3] ac-ft/yr were determined. These amounts are significant due to abnormally high per capita usage developed by TWDB from reported 2011 usage. The conservation savings are adequate to alleviate the shortage for Texarkana, pending development of the proposed new water treatment facility to replace existing infrastructure" (Texas Water Development Board, 2015c).

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region D, one utility met these criteria, Texarkana. The leadership at this utility accepted the invitation to participate in the study.

Texarkana represents nearly five percent of the 2020 population of Region D and represents 99.5 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Texarkana received a report on the results of its water conservation activities and water loss effortsand is included as a part of this report. This report summarizes the savings from the individual utility report within Region D.

4 Regional planning group approach to municipal water conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water

[3] The value listed for Texarkana in the written text of the Region D Water Plan is actually 6,815 ac-ft/yr. The Interactive State Water Plan has a value of 6,728 acre-feet per year by 2070.

Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

The Region D planners recommended 140 GPCD[4] as the threshold for determining to which WUGs conservation strategies should apply. The target 140 GPCD was selected to match the recommendation of the State Water Conservation Implementation Task Force. Cost effectiveness is the overriding criteria when evaluating water conservation strategies (Texas Water Development Board, 2016e).

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

4.2 Approach to Meeting Recommended Supply Volumes

The North East Texas Regional Water Planning Group (NETRWPG) identified one entity within the region to which advanced conservation strategies should apply—the City of Texarkana. Advanced conservation strategies recommended by the planning group are:

- Single-family Clothes Washer Rebates
- Single-family Irrigation Audits
- Single-family Rainwater Harvesting
- Single-family Rain Barrels
- Multi-family Clothes Washer Rebates
- Multi-family Irrigation Audits
- Multi-family Rainwater Harvesting
- Commercial Clothes Washer Rebates (coin-operated)
- Commercial Irrigation Audits
- Commercial Rainwater Harvesting

Savings from these strategies "…are adequate to alleviate the shortage for Texarkana…"

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the City of Texarkana. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (Since 2011) in Region D.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
D	1	0	0	1	0	0	0	0	0	0	0	2	2.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately to ensure Region D is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities re being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[5] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[6] for that year.[7] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the

---

[5] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[6] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[7] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

difference between each individual utility's baseline[8] for water loss GPCD[9] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

---

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting its Municipal Conservation Supply Volumes?

Table 7-1 shows how the region's participating utility's quantified savings estimates are progressing toward meeting its 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the one participating utility. This utility constitutes approximately five percent of the region's population and account for 99.5 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation activity savings for participating utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water loss reduction savings (as of 2015) for participating utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total savings from all conservation activity for participating utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS volume for participating utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water loss reduction WMS volume for participating utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total yearly WMS volume for participating utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (In Acre-Feet Per Year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	317	1,132	1,449	2,846	0	2,846	(1,397)
2016	317	1,133	1,451	3,557	0	3,557	(2,106)
2017	318	1,135	1,453	3,557	0	3,557	(2,105)
2018	318	1,136	1,454	4,269	0	4,269	(2,814)
2019	319	1,137	1,456	4,980	0	4,980	(3,524)
2020	319	1,138	1,458	6,403	0	6,403	(4,945)
2021	320	1,142	1,461	6,429	0	6,429	(4,968)
2022	320	1,145	1,465	6,455	0	6,455	(4,990)
2023	321	1,148	1,469	6,481	0	6,481	(5,013)
2024	321	1,151	1,472	6,507	0	6,507	(5,035)
2025	322	1,155	1,476	6,534	0	6,534	(5,057)
2026	322	1,158	1,480	6,560	0	6,560	(5,080)
2027	323	1,161	1,484	6,586	0	6,586	(5,102)
2028	323	1,164	1,487	6,612	0	6,612	(5,125)
2029	324	1,167	1,491	6,638	0	6,638	(5,147)
2030	324	1,171	1,495	6,664	0	6,664	(5,169)
2031	324	1,172	1,496	6,679	0	6,679	(5,184)
2032	324	1,173	1,497	6,694	0	6,694	(5,198)
2033	324	1,174	1,497	6,709	0	6,709	(5,212)
2034	324	1,175	1,498	6,724	0	6,724	(5,226)
2035	324	1,176	1,499	6,740	0	6,740	(5,240)
2036	324	1,177	1,500	6,755	0	6,755	(5,254)
2037	324	1,178	1,501	6,770	0	6,770	(5,268)
2038	324	1,179	1,502	6,785	0	6,785	(5,283)
2039	324	1,180	1,503	6,800	0	6,800	(5,297)
2040	323	1,181	1,504	6,815	0	6,815	(5,311)
2041	323	1,181	1,504	6,808	0	6,808	(5,304)
2042	323	1,181	1,504	6,800	0	6,800	(5,297)
2043	323	1,181	1,504	6,793	0	6,793	(5,289)
2044	323	1,181	1,503	6,786	0	6,786	(5,282)
2045	323	1,181	1,503	6,779	0	6,779	(5,275)
2046	322	1,181	1,503	6,771	0	6,771	(5,268)
2047	322	1,181	1,503	6,764	0	6,764	(5,261)
2048	322	1,181	1,503	6,757	0	6,757	(5,254)
2049	322	1,181	1,503	6,749	0	6,749	(5,247)
2050	322	1,181	1,502	6,742	0	6,742	(5,240)
2051	322	1,181	1,502	6,741	0	6,741	(5,238)
2052	322	1,181	1,502	6,739	0	6,739	(5,237)
2053	322	1,181	1,502	6,738	0	6,738	(5,236)
2054	321	1,181	1,502	6,737	0	6,737	(5,235)
2055	321	1,181	1,502	6,736	0	6,736	(5,233)
2056	321	1,181	1,502	6,734	0	6,734	(5,232)
2057	321	1,181	1,502	6,733	0	6,733	(5,231)
2058	321	1,181	1,502	6,732	0	6,732	(5,230)
2059	321	1,181	1,502	6,730	0	6,730	(5,228)
2060	321	1,181	1,502	6,729	0	6,729	(5,227)
2061	321	1,181	1,502	6,729	0	6,729	(5,227)
2062	321	1,181	1,502	6,729	0	6,729	(5,227)
2063	321	1,181	1,502	6,729	0	6,729	(5,227)
2064	321	1,181	1,502	6,729	0	6,729	(5,227)
2065	321	1,181	1,502	6,729	0	6,729	(5,226)
2066	321	1,181	1,502	6,728	0	6,728	(5,226)
2067	321	1,181	1,502	6,728	0	6,728	(5,226)
2068	321	1,181	1,502	6,728	0	6,728	(5,226)
2069	321	1,181	1,502	6,728	0	6,728	(5,226)
2070	321	1,181	1,502	6,728	0	6,728	(5,226)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole. As there is only one participating utility in this region, the table shows Texarkana's' decadal shortfalls.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
D	Meeting		0		0		0		0		0		0
	Not Meeting	1	(4,945)	1	(5,169)	1	(5,311)	1	(5,240)	1	(5,227)	1	(5,226)
	Total Region D	1	(4,945)	1	(5,169)	1	(5,311)	1	(5,240)	1	(5,227)	1	(5,226)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from all Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	317	1,132	1,449	2,860	(1,410)
2016	317	1,133	1,451	3,574	(2,124)
2017	318	1,135	1,453	3,574	(2,122)
2018	318	1,136	1,454	4,289	(2,835)
2019	319	1,137	1,456	5,004	(3,548)
2020	319	1,138	1,458	6,434	(4,976)
2021	320	1,142	1,461	6,462	(5,001)
2022	320	1,145	1,465	6,491	(5,026)
2023	321	1,148	1,469	6,519	(5,050)
2024	321	1,151	1,472	6,547	(5,075)
2025	322	1,155	1,476	6,576	(5,099)
2026	322	1,158	1,480	6,604	(5,124)
2027	323	1,161	1,484	6,632	(5,149)
2028	323	1,164	1,487	6,660	(5,173)
2029	324	1,167	1,491	6,689	(5,198)
2030	324	1,171	1,495	6,717	(5,222)
2031	324	1,172	1,496	6,734	(5,238)
2032	324	1,173	1,497	6,750	(5,254)
2033	324	1,174	1,497	6,767	(5,270)
2034	324	1,175	1,498	6,784	(5,285)
2035	324	1,176	1,499	6,801	(5,301)
2036	324	1,177	1,500	6,817	(5,317)
2037	324	1,178	1,501	6,834	(5,333)
2038	324	1,179	1,502	6,851	(5,348)
2039	324	1,180	1,503	6,867	(5,364)
2040	323	1,181	1,504	6,884	(5,380)
2041	323	1,181	1,504	6,879	(5,375)
2042	323	1,181	1,504	6,874	(5,371)
2043	323	1,181	1,504	6,870	(5,366)
2044	323	1,181	1,503	6,865	(5,361)
2045	323	1,181	1,503	6,860	(5,357)
2046	322	1,181	1,503	6,855	(5,352)
2047	322	1,181	1,503	6,850	(5,348)
2048	322	1,181	1,503	6,846	(5,343)
2049	322	1,181	1,503	6,841	(5,338)
2050	322	1,181	1,502	6,836	(5,334)
2051	322	1,181	1,502	6,837	(5,335)
2052	322	1,181	1,502	6,838	(5,336)
2053	322	1,181	1,502	6,840	(5,337)
2054	321	1,181	1,502	6,841	(5,339)
2055	321	1,181	1,502	6,842	(5,340)
2056	321	1,181	1,502	6,843	(5,341)
2057	321	1,181	1,502	6,844	(5,342)
2058	321	1,181	1,502	6,846	(5,344)
2059	321	1,181	1,502	6,847	(5,345)
2060	321	1,181	1,502	6,848	(5,346)
2061	321	1,181	1,502	6,851	(5,349)
2062	321	1,181	1,502	6,854	(5,352)
2063	321	1,181	1,502	6,856	(5,354)
2064	321	1,181	1,502	6,859	(5,357)
2065	321	1,181	1,502	6,862	(5,360)
2066	321	1,181	1,502	6,865	(5,363)
2067	321	1,181	1,502	6,868	(5,366)
2068	321	1,181	1,502	6,870	(5,368)
2069	321	1,181	1,502	6,873	(5,371)
2070	321	1,181	1,502	6,876	(5,374)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[12] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-Home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

aerators, toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from most widely used conservation activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	1,132			317									1,449
2016	1,133			317									1,451
2017	1,135			318									1,453
2018	1,136			318									1,454
2019	1,137			319									1,456
2020	1,138			319									1,458
2021	1,142			320									1,461
2022	1,145			320									1,465
2023	1,148			321									1,469
2024	1,151			321									1,472
2025	1,155			322									1,476
2026	1,158			322									1,480
2027	1,161			323									1,484
2028	1,164			323									1,487
2029	1,167			324									1,491
2030	1,171			324									1,495
2031	1,172			324									1,496
2032	1,173			324									1,497
2033	1,174			324									1,497
2034	1,175			324									1,498
2035	1,176			324									1,499
2036	1,177			324									1,500
2037	1,178			324									1,501
2038	1,179			324									1,502
2039	1,180			324									1,503
2040	1,181			323									1,504
2041	1,181			323									1,504
2042	1,181			323									1,504
2043	1,181			323									1,504
2044	1,181			323									1,503
2045	1,181			323									1,503
2046	1,181			322									1,503
2047	1,181			322									1,503
2048	1,181			322									1,503
2049	1,181			322									1,503
2050	1,181			322									1,502
2051	1,181			322									1,502
2052	1,181			322									1,502
2053	1,181			322									1,502
2054	1,181			321									1,502
2055	1,181			321									1,502
2056	1,181			321									1,502
2057	1,181			321									1,502
2058	1,181			321									1,502
2059	1,181			321									1,502
2060	1,181			321									1,502
2061	1,181			321									1,502
2062	1,181			321									1,502
2063	1,181			321									1,502
2064	1,181			321									1,502
2065	1,181			321									1,502
2066	1,181			321									1,502
2067	1,181			321									1,502
2068	1,181			321									1,502
2069	1,181			321									1,502
2070	1,181			321									1,502

9 Region D Challenges

Listed below are challenges the NETRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

Utilities often do not know what their role is regarding regional conservation supply volumes. It will be important to continue to monitor and communicate progress on the WMS supply volume.

10 Recommendations

Listed below are recommendations for the NETRWPG and utilities.

10.1 Participation And Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The NETRWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them

something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The NETRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities around the state are considering Advanced Metering Infrastructure. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and NETRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the NETRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess” a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

Region D should consider implementing twice a week watering ordinances, deployment of AMI with customer portal, strategic water rate increases and rain barrels as cost effective means to advance municipal conservation. Details were supplied in the report to Texarkana.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Far West Texas Water Planning Group
Region E • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region E make up approximately 770,000 in population by 2020, which is 80 percent of the region's total projected 2020 population.
- Participating utilities make up 88 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of two participating water utilities in place—and without further enhancement—Region E as a whole is projected to exceed its recommended 2020 water conservation supply volume by 13,275 acre-feet per year.
- With the current conservation activities of two participating water utilities in place—and without further enhancement—these two utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 13,527 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 13,954 acre-feet per year.
- Of those utilities surveyed, the region averages four activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region E encompasses the most arid region of the State of Texas. The seven-county region lies within the Rio Grande River Basin. With the exception of El Paso County, the counties of far West Texas are among the least populated in the State. Region E is not considered a rapid growth region.

The Region E Plan states, "[w]ater conservation is one of the most important components of water supply management. Recognizing its impact, setting realistic goals, and aggressively enforcing implementation, may significantly extend the time when new supplies and associated infrastructure are needed." The plan calls for 6,408 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016d). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region E are 2,159, acre-feet per year for 2020, 2,449 acre-feet per year for 2030, 1,539 acre-feet per year for 2040, 2,972 acre-feet per year for 2050, and 5,991 acre-feet per year for 2060.

(shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region E, two utilities met these criteria and were contacted for participation. Horizon Regional MUD accepted and participated in the study. In order to get a fuller picture of savings occurring in Region E, the City of El Paso (El Paso Water) also agreed to participate.

These two utilities represent 80 percent of the 2020 population of Region E and 88 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts. This report summarizes the savings from the individual utility reports within Region E.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

Quantity, reliability, and cost were the criteria considered when recommending water conservation strategies for Region E. Savings were not estimated for each individual strategy. Planners expect to reduce demand by about three GPCD per decade (Texas Water Development Board, 2016d)

The Far West Texas Water Planning Group (FWTWPG) group recommends three strategies to be implemented by the utilities within the region:

- Reuse of treated wastewater
- Water loss audit and main-line repair
- Public education

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region E. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region E.

Region	Water Loss Reduction	Water Rate Increases	3x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
E	2	0	2	0	0	0	0	0	0	1	3	8	4.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately to ensure Region E is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process

to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility’s baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

---

divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.

- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain

> volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting its Municipal Conservation Supply Volumes?

The 2016 Far West Texas Water Plan recommends that Region E should achieve 6,408 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The participating utilities' portion of this recommended supply volume is 6,009 acre-feet per year. The results of this study indicate that Region E is estimated to exceed its recommended supply volume by an estimated 13,954 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 399 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the two participating utilities. These utilities constitute approximately 80 percent of the region's population and account for 88 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

---

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	12,825	(1,243)	11,582	848	0	848	10,735
2016	16,770	(1,262)	15,508	1,059	0	1,059	14,448
2017	16,505	(1,281)	15,224	1,059	0	1,059	14,165
2018	16,594	(1,300)	15,294	1,271	0	1,271	14,023
2019	16,683	(1,319)	15,364	1,483	0	1,483	13,881
2020	16,772	(1,338)	15,434	1,907	0	1,907	13,527
2021	16,861	(1,352)	15,508	1,932	0	1,932	13,576
2022	16,978	(1,367)	15,612	1,958	0	1,958	13,654
2023	16,958	(1,381)	15,577	1,983	0	1,983	13,594
2024	16,938	(1,396)	15,542	2,008	0	2,008	13,533
2025	16,918	(1,411)	15,507	2,034	0	2,034	13,473
2026	16,897	(1,425)	15,472	2,059	0	2,059	13,413
2027	17,015	(1,440)	15,575	2,084	0	2,084	13,491
2028	17,133	(1,455)	15,678	2,109	0	2,109	13,569
2029	17,251	(1,469)	15,781	2,135	0	2,135	13,646
2030	17,368	(1,484)	15,884	2,160	0	2,160	13,724
2031	17,482	(1,499)	15,982	2,066	0	2,066	13,916
2032	17,595	(1,515)	16,081	1,973	0	1,973	14,108
2033	17,709	(1,530)	16,179	1,879	0	1,879	14,300
2034	17,822	(1,545)	16,277	1,785	0	1,785	14,492
2035	17,936	(1,561)	16,375	1,692	0	1,692	14,683
2036	18,049	(1,576)	16,473	1,598	0	1,598	14,875
2037	18,162	(1,591)	16,571	1,504	0	1,504	15,067
2038	18,276	(1,607)	16,669	1,410	0	1,410	15,259
2039	18,389	(1,622)	16,767	1,317	0	1,317	15,451
2040	18,503	(1,637)	16,865	1,223	0	1,223	15,642
2041	18,626	(1,659)	16,967	1,363	0	1,363	15,603
2042	18,749	(1,681)	17,068	1,504	0	1,504	15,564
2043	18,872	(1,703)	17,169	1,644	0	1,644	15,526
2044	18,996	(1,725)	17,271	1,784	0	1,784	15,487
2045	19,119	(1,747)	17,372	1,925	0	1,925	15,448
2046	19,242	(1,769)	17,474	2,065	0	2,065	15,409
2047	19,365	(1,790)	17,575	2,205	0	2,205	15,370
2048	19,489	(1,812)	17,676	2,345	0	2,345	15,331
2049	19,612	(1,834)	17,778	2,486	0	2,486	15,292
2050	19,735	(1,856)	17,879	2,626	0	2,626	15,253
2051	19,862	(1,877)	17,985	2,925	0	2,925	15,060
2052	19,989	(1,898)	18,091	3,224	0	3,224	14,867
2053	20,116	(1,918)	18,198	3,524	0	3,524	14,674
2054	20,243	(1,939)	18,304	3,823	0	3,823	14,481
2055	20,370	(1,960)	18,410	4,122	0	4,122	14,288
2056	20,497	(1,980)	18,516	4,421	0	4,421	14,095
2057	20,624	(2,001)	18,623	4,720	0	4,720	13,902
2058	20,751	(2,022)	18,729	5,020	0	5,020	13,709
2059	20,878	(2,042)	18,835	5,319	0	5,319	13,516
2060	21,005	(2,063)	18,941	5,618	0	5,618	13,323
2061	21,126	(2,083)	19,044	5,657	0	5,657	13,386
2062	21,248	(2,102)	19,146	5,696	0	5,696	13,450
2063	21,369	(2,122)	19,248	5,735	0	5,735	13,513
2064	21,491	(2,141)	19,350	5,774	0	5,774	13,576
2065	21,613	(2,161)	19,452	5,814	0	5,814	13,639
2066	21,734	(2,180)	19,554	5,853	0	5,853	13,702
2067	21,856	(2,199)	19,657	5,892	0	5,892	13,765
2068	21,978	(2,219)	19,759	5,931	0	5,931	13,828
2069	22,099	(2,238)	19,861	5,970	0	5,970	13,891
2070	22,221	(2,258)	19,963	6,009	0	6,009	13,954

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
E	Meeting	1	13,875	1	14,056	1	15,980	1	15,661	1	13,796	1	14,489
	Not Meeting	1	(348)	1	(332)	1	(338)	1	(408)	1	(473)	1	(535)
	Total Region E	2	13,527	2	13,724	2	15,642	2	15,253	2	13,323	2	13,954

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	12,825	(1,243)	11,582	960	10,623
2016	16,770	(1,262)	15,508	1,199	14,308
2017	16,505	(1,281)	15,224	1,199	14,025
2018	16,594	(1,300)	15,294	1,439	13,855
2019	16,683	(1,319)	15,364	1,679	13,685
2020	16,772	(1,338)	15,434	2,159	13,275
2021	16,861	(1,352)	15,508	2,188	13,320
2022	16,978	(1,367)	15,612	2,217	13,395
2023	16,958	(1,381)	15,577	2,246	13,331
2024	16,938	(1,396)	15,542	2,275	13,267
2025	16,918	(1,411)	15,507	2,304	13,203
2026	16,897	(1,425)	15,472	2,333	13,139
2027	17,015	(1,440)	15,575	2,362	13,213
2028	17,133	(1,455)	15,678	2,391	13,287
2029	17,251	(1,469)	15,781	2,420	13,361
2030	17,368	(1,484)	15,884	2,449	13,435
2031	17,482	(1,499)	15,982	2,358	13,624
2032	17,595	(1,515)	16,081	2,267	13,814
2033	17,709	(1,530)	16,179	2,176	14,003
2034	17,822	(1,545)	16,277	2,085	14,192
2035	17,936	(1,561)	16,375	1,994	14,381
2036	18,049	(1,576)	16,473	1,903	14,570
2037	18,162	(1,591)	16,571	1,812	14,759
2038	18,276	(1,607)	16,669	1,721	14,948
2039	18,389	(1,622)	16,767	1,630	15,137
2040	18,503	(1,637)	16,865	1,539	15,326
2041	18,626	(1,659)	16,967	1,682	15,284
2042	18,749	(1,681)	17,068	1,826	15,242
2043	18,872	(1,703)	17,169	1,969	15,201
2044	18,996	(1,725)	17,271	2,112	15,159
2045	19,119	(1,747)	17,372	2,256	15,117
2046	19,242	(1,769)	17,474	2,399	15,075
2047	19,365	(1,790)	17,575	2,542	15,033
2048	19,489	(1,812)	17,676	2,685	14,991
2049	19,612	(1,834)	17,778	2,829	14,949
2050	19,735	(1,856)	17,879	2,972	14,907
2051	19,862	(1,877)	17,985	3,274	14,711
2052	19,989	(1,898)	18,091	3,576	14,516
2053	20,116	(1,918)	18,198	3,878	14,320
2054	20,243	(1,939)	18,304	4,180	14,124
2055	20,370	(1,960)	18,410	4,482	13,929
2056	20,497	(1,980)	18,516	4,783	13,733
2057	20,624	(2,001)	18,623	5,085	13,537
2058	20,751	(2,022)	18,729	5,387	13,342
2059	20,878	(2,042)	18,835	5,689	13,146
2060	21,005	(2,063)	18,941	5,991	12,950
2061	21,126	(2,083)	19,044	6,033	13,011
2062	21,248	(2,102)	19,146	6,074	13,071
2063	21,369	(2,122)	19,248	6,116	13,132
2064	21,491	(2,141)	19,350	6,158	13,192
2065	21,613	(2,161)	19,452	6,200	13,253
2066	21,734	(2,180)	19,554	6,241	13,313
2067	21,856	(2,199)	19,657	6,283	13,374
2068	21,978	(2,219)	19,759	6,325	13,434
2069	22,099	(2,238)	19,861	6,366	13,495
2070	22,221	(2,258)	19,963	6,408	13,555

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

3x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to three times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	3x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	(1,243)	0	6,044								1,774	5,008	11,582
2016	(1,262)	3,755	6,105								1,774	5,136	15,508
2017	(1,281)	6,201	6,167								1,774	2,364	15,224
2018	(1,300)	6,257	6,229								1,774	2,335	15,294
2019	(1,319)	6,313	6,290								1,774	2,306	15,364
2020	(1,338)	6,369	6,352								1,774	2,277	15,434
2021	(1,352)	6,425	6,414								1,774	2,248	15,508
2022	(1,367)	6,481	6,475								1,774	2,248	15,612
2023	(1,381)	6,537	6,537								1,774	2,110	15,577
2024	(1,396)	6,593	6,599								1,774	1,972	15,542
2025	(1,411)	6,650	6,660								1,774	1,834	15,507
2026	(1,425)	6,706	6,722								1,774	1,696	15,472
2027	(1,440)	6,762	6,784								1,774	1,696	15,575
2028	(1,455)	6,818	6,845								1,774	1,696	15,678
2029	(1,469)	6,874	6,907								1,774	1,696	15,781
2030	(1,484)	6,930	6,969								1,774	1,696	15,884
2031	(1,499)	6,984	7,028								1,774	1,696	15,982
2032	(1,515)	7,038	7,087								1,774	1,696	16,081
2033	(1,530)	7,093	7,147								1,774	1,696	16,179
2034	(1,545)	7,147	7,206								1,774	1,696	16,277
2035	(1,561)	7,201	7,265								1,774	1,696	16,375
2036	(1,576)	7,255	7,325								1,774	1,696	16,473
2037	(1,591)	7,309	7,384								1,774	1,696	16,571
2038	(1,607)	7,363	7,443								1,774	1,696	16,669
2039	(1,622)	7,417	7,503								1,774	1,696	16,767
2040	(1,637)	7,471	7,562								1,774	1,696	16,865
2041	(1,659)	7,531	7,626								1,774	1,696	16,967
2042	(1,681)	7,590	7,690								1,774	1,696	17,068
2043	(1,703)	7,649	7,754								1,774	1,696	17,169
2044	(1,725)	7,708	7,818								1,774	1,696	17,271
2045	(1,747)	7,767	7,882								1,774	1,696	17,372
2046	(1,769)	7,826	7,946								1,774	1,696	17,474
2047	(1,790)	7,885	8,011								1,774	1,696	17,575
2048	(1,812)	7,944	8,075								1,774	1,696	17,676
2049	(1,834)	8,004	8,139								1,774	1,696	17,778
2050	(1,856)	8,063	8,203								1,774	1,696	17,879
2051	(1,877)	8,124	8,269								1,774	1,696	17,985
2052	(1,898)	8,185	8,334								1,774	1,696	18,091
2053	(1,918)	8,246	8,400								1,774	1,696	18,198
2054	(1,939)	8,308	8,466								1,774	1,696	18,304
2055	(1,960)	8,369	8,532								1,774	1,696	18,410
2056	(1,980)	8,430	8,597								1,774	1,696	18,516
2057	(2,001)	8,491	8,663								1,774	1,696	18,623
2058	(2,022)	8,552	8,729								1,774	1,696	18,729
2059	(2,042)	8,613	8,795								1,774	1,696	18,835
2060	(2,063)	8,675	8,860								1,774	1,696	18,941
2061	(2,083)	8,733	8,923								1,774	1,696	19,044
2062	(2,102)	8,792	8,986								1,774	1,696	19,146
2063	(2,122)	8,851	9,049								1,774	1,696	19,248
2064	(2,141)	8,909	9,112								1,774	1,696	19,350
2065	(2,161)	8,968	9,175								1,774	1,696	19,452
2066	(2,180)	9,027	9,238								1,774	1,696	19,554
2067	(2,199)	9,086	9,301								1,774	1,696	19,657
2068	(2,219)	9,144	9,364								1,774	1,696	19,759
2069	(2,238)	9,203	9,427								1,774	1,696	19,861
2070	(2,258)	9,262	9,490								1,774	1,696	19,963

9 Region E Challenges

Listed below are challenges the FWTWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- The study found that smaller utilities in El Paso County were acutely aware of the need for and value of municipal conservation. For the most part, they follow the lead of El Paso.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout West Texas is relatively low. Traditional municipal conservation activities, therefore, are not seen as particularly necessary.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the FWTWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The FWTWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. For this project, each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The FWTWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar future data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities around the state are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and FWTWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the FWTWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE

offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess” a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region E, the most common suggested activities were to install AMI with a customer engagement portal to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Region F Regional Water Planning Group • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region F make up approximately 400,000 in population by 2020, which is 57 percent of the region's total projected 2020 population.
- Participating utilities make up 58 percent of the region's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of 10 participating water utilities in place—and without further enhancement—Region F as a whole is projected to

exceed its recommended 2020 water conservation supply volume by 2,739 acre-feet per year.

- With the current conservation activities of 10 participating water utilities in place—and without further enhancement—these 10 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 4,566 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 6,662 acre-feet per year.
- Of those utilities surveyed, the region averages 1.8 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region F is a 32-county area of West Texas. It is a sparsely populated, agricultural region with a heavy oil and gas presence. Although it is not a rapidly growing region, it is prone to population fluctuations due to the volatility of the oil and gas industry.

The Region F Plan states, "[w]ater conservation is a potentially feasible water savings strategy that can be used to preserve the supplies of existing water resources. For municipalities and manufacturers, advanced drought planning and conservation can be used to protect their water supplies and increase reliability during drought conditions." The plan calls for 6,183 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016e). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region F are 4,344 acre-feet per year for 2020, 4,765 acre-feet per year for 2030, 5,115 acre-feet per year for 2040, 5,477 acre-feet per year for 2050, and 5,817 acre-feet per year for 2060.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region F, 14 utilities met these criteria and were contacted for participation. Out of the 14, 10 utilities accepted and were included in our results:

Andrews	Midland
Ballinger	Odessa
Brady	San Angelo
Coleman	Snyder
Junction	Winters

These utilities represent 57 percent of the 2020 population of Region F and 58 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts. This report summarizes the savings from the individual utility reports within Region F.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

The Region F Water Planning Group (RFWPG) considered the following criteria when recommending conservation strategies to the WUGs within the region (Texas Water Development Board, 2016e):

- Cost
- Potential Water Savings
- Time to Implement
- Public Acceptance
- Technical Feasibility
- Staff Resources

Published reports and previous studies were used to estimate savings of the BMPs. The planners noted that water savings for some BMPs were difficult to estimate because there is a lack of sufficient data.

Selected strategies for utilities in Region F:

- Education and Outreach – assumed savings would be two percent of total water demand
- Water Audits and Leak Repair – assumed 20 percent of entities losses could be recovered

- Rate Structure – assumed that 10 percent of households would save 6,000 gallons annually
- Landscape Ordinance – assumed savings of 1,000 gallons per increased number of households annually for utilities over 20,000 population
- Time-of-Day Watering Limit – assumed that 75 percent of the population would realize 1,000 galloons/household per year for utilities over 20,000 population
- Water Waste Ordinance – assumed savings of 3,000 gallons/household/year for 75 percent of households.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region F. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region F.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
F	10	7	1	0	0	0	0	0	0	0	0	18	1.8

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region F is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, our approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).
[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into our estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited our ability to collect full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Region F Water Plan recommends that Region F should achieve 6,183 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the 10 utilities surveyed in this region are estimated to exceed their portion (3,941 acre-feet per year) by 6,662 acre-feet per year by 2070. Non-participating municipal WUGs have a WMS supply volume for municipal conservation of 2,242 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 10 participating utilities. These utilities constitute approximately 57 percent of the region's population and account for 58 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Conservation WMS Volume for Participating Utilities</u> – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

<u>Water Loss Reduction WMS Volume for Participating Utilities</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume for Participating Utilities</u> – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

<u>Over (Short)</u> – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	2,324	1,757	4,080	1,119	0	1,119	2,962
2016	4,798	1,746	6,544	1,398	0	1,398	5,145
2017	5,233	1,735	6,967	1,398	0	1,398	5,569
2018	5,282	1,724	7,005	1,678	0	1,678	5,327
2019	5,330	1,713	7,043	1,958	0	1,958	5,085
2020	5,379	1,703	7,083	2,517	0	2,517	4,566
2021	5,428	1,724	7,152	2,548	0	2,548	4,604
2022	5,477	1,744	7,221	2,578	0	2,578	4,643
2023	5,526	1,765	7,290	2,609	0	2,609	4,682
2024	5,574	1,785	7,359	2,639	0	2,639	4,720
2025	5,623	1,805	7,428	2,670	0	2,670	4,759
2026	5,672	1,809	7,481	2,700	0	2,700	4,781
2027	5,721	1,829	7,550	2,731	0	2,731	4,819
2028	5,769	1,850	7,619	2,761	0	2,761	4,858
2029	5,818	1,870	7,688	2,792	0	2,792	4,897
2030	5,867	1,891	7,758	2,822	0	2,822	4,936
2031	5,911	1,910	7,821	2,850	0	2,850	4,971
2032	5,955	1,930	7,885	2,877	0	2,877	5,008
2033	5,999	1,950	7,949	2,905	0	2,905	5,044
2034	6,043	1,970	8,012	2,932	0	2,932	5,080
2035	6,087	1,990	8,076	2,960	0	2,960	5,116
2036	6,130	2,009	8,140	2,988	0	2,988	5,152
2037	6,174	2,029	8,204	3,015	0	3,015	5,188
2038	6,218	2,049	8,267	3,043	0	3,043	5,225
2039	6,262	2,069	8,331	3,070	0	3,070	5,261
2040	6,306	2,089	8,395	3,098	0	3,098	5,297
2041	6,356	2,108	8,464	3,125	0	3,125	5,339
2042	6,405	2,128	8,534	3,151	0	3,151	5,382
2043	6,455	2,149	8,603	3,178	0	3,178	5,425
2044	6,504	2,169	8,673	3,205	0	3,205	5,468
2045	6,554	2,189	8,743	3,232	0	3,232	5,511
2046	6,603	2,209	8,812	3,258	0	3,258	5,554
2047	6,653	2,229	8,882	3,285	0	3,285	5,597
2048	6,703	2,249	8,952	3,312	0	3,312	5,640
2049	6,752	2,269	9,021	3,338	0	3,338	5,683
2050	6,802	2,289	9,091	3,365	0	3,365	5,726
2051	6,856	2,309	9,165	3,392	0	3,392	5,773
2052	6,911	2,329	9,240	3,419	0	3,419	5,821
2053	6,966	2,349	9,315	3,447	0	3,447	5,868
2054	7,020	2,369	9,389	3,474	0	3,474	5,916
2055	7,075	2,389	9,464	3,501	0	3,501	5,963
2056	7,129	2,409	9,539	3,528	0	3,528	6,011
2057	7,184	2,430	9,614	3,555	0	3,555	6,058
2058	7,239	2,450	9,688	3,583	0	3,583	6,106
2059	7,293	2,470	9,763	3,610	0	3,610	6,153
2060	7,348	2,490	9,837	3,637	0	3,637	6,200
2061	7,404	2,509	9,914	3,667	0	3,667	6,246
2062	7,461	2,529	9,990	3,698	0	3,698	6,292
2063	7,517	2,549	10,066	3,728	0	3,728	6,338
2064	7,573	2,569	10,142	3,759	0	3,759	6,384
2065	7,630	2,589	10,218	3,789	0	3,789	6,429
2066	7,686	2,609	10,295	3,819	0	3,819	6,475
2067	7,742	2,629	10,371	3,850	0	3,850	6,521
2068	7,799	2,649	10,447	3,880	0	3,880	6,567
2069	7,855	2,668	10,523	3,911	0	3,911	6,613
2070	7,911	2,691	10,603	3,941	0	3,941	6,662

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
F	Meeting	5	5,039	5	5,457	5	5,882	5	6,365	5	6,895	5	7,441
	Not Meeting	5	(473)	5	(521)	5	(585)	5	(639)	5	(695)	5	(779)
	Total Region F	10	4,566	10	4,936	10	5,297	10	5,726	10	6,200	10	6,662

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	2,324	1,757	4,080	1,931	2,150
2016	4,798	1,746	6,544	2,413	4,130
2017	5,233	1,735	6,967	2,413	4,554
2018	5,282	1,724	7,005	2,896	4,109
2019	5,330	1,713	7,043	3,379	3,664
2020	5,379	1,703	7,083	4,344	2,739
2021	5,428	1,724	7,152	4,386	2,766
2022	5,477	1,744	7,221	4,428	2,793
2023	5,526	1,765	7,290	4,470	2,820
2024	5,574	1,785	7,359	4,512	2,847
2025	5,623	1,805	7,428	4,555	2,874
2026	5,672	1,809	7,481	4,597	2,884
2027	5,721	1,829	7,550	4,639	2,911
2028	5,769	1,850	7,619	4,681	2,938
2029	5,818	1,870	7,688	4,723	2,965
2030	5,867	1,891	7,758	4,765	2,993
2031	5,911	1,910	7,821	4,800	3,021
2032	5,955	1,930	7,885	4,835	3,050
2033	5,999	1,950	7,949	4,870	3,079
2034	6,043	1,970	8,012	4,905	3,107
2035	6,087	1,990	8,076	4,940	3,136
2036	6,130	2,009	8,140	4,975	3,165
2037	6,174	2,029	8,204	5,010	3,194
2038	6,218	2,049	8,267	5,045	3,222
2039	6,262	2,069	8,331	5,080	3,251
2040	6,306	2,089	8,395	5,115	3,280
2041	6,356	2,108	8,464	5,151	3,313
2042	6,405	2,128	8,534	5,187	3,346
2043	6,455	2,149	8,603	5,224	3,380
2044	6,504	2,169	8,673	5,260	3,413
2045	6,554	2,189	8,743	5,296	3,447
2046	6,603	2,209	8,812	5,332	3,480
2047	6,653	2,229	8,882	5,368	3,514
2048	6,703	2,249	8,952	5,405	3,547
2049	6,752	2,269	9,021	5,441	3,581
2050	6,802	2,289	9,091	5,477	3,614
2051	6,856	2,309	9,165	5,511	3,654
2052	6,911	2,329	9,240	5,545	3,695
2053	6,966	2,349	9,315	5,579	3,736
2054	7,020	2,369	9,389	5,613	3,776
2055	7,075	2,389	9,464	5,647	3,817
2056	7,129	2,409	9,539	5,681	3,858
2057	7,184	2,430	9,614	5,715	3,899
2058	7,239	2,450	9,688	5,749	3,939
2059	7,293	2,470	9,763	5,783	3,980
2060	7,348	2,490	9,837	5,817	4,020
2061	7,404	2,509	9,914	5,854	4,060
2062	7,461	2,529	9,990	5,890	4,100
2063	7,517	2,549	10,066	5,927	4,139
2064	7,573	2,569	10,142	5,963	4,179
2065	7,630	2,589	10,218	6,000	4,218
2066	7,686	2,609	10,295	6,037	4,258
2067	7,742	2,629	10,371	6,073	4,298
2068	7,799	2,649	10,447	6,110	4,337
2069	7,855	2,668	10,523	6,146	4,377
2070	7,911	2,691	10,603	6,183	4,420

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	1,757	1,008	1,316										4,079
2016	1,746	3,469	1,330										6,543
2017	1,735	3,890	1,343										6,968
2018	1,724	3,925	1,356										7,007
2019	1,713	3,961	1,370										7,042
2020	1,703	3,996	1,383										7,081
2021	1,724	4,032	1,396										7,152
2022	1,744	4,067	1,410										7,221
2023	1,765	4,103	1,423										7,289
2024	1,785	4,138	1,436										7,361
2025	1,805	4,174	1,450										7,429
2026	1,809	4,209	1,463										7,480
2027	1,829	4,244	1,476										7,549
2028	1,850	4,280	1,490										7,620
2029	1,870	4,315	1,503										7,689
2030	1,891	4,351	1,516										7,757
2031	1,910	4,388	1,523										7,822
2032	1,930	4,426	1,529										7,885
2033	1,950	4,463	1,535										7,947
2034	1,970	4,501	1,542										8,013
2035	1,990	4,538	1,548										8,076
2036	2,009	4,576	1,555										8,139
2037	2,029	4,613	1,561										8,204
2038	2,049	4,651	1,568										8,267
2039	2,069	4,688	1,574										8,330
2040	2,089	4,726	1,581										8,396
2041	2,108	4,767	1,589										8,464
2042	2,128	4,808	1,597										8,533
2043	2,149	4,850	1,605										8,602
2044	2,169	4,891	1,613										8,674
2045	2,189	4,933	1,621										8,743
2046	2,209	4,974	1,630										8,812
2047	2,229	5,015	1,638										8,881
2048	2,249	5,057	1,646										8,953
2049	2,269	5,098	1,654										9,022
2050	2,289	5,139	1,662										9,090
2051	2,309	5,184	1,672										9,165
2052	2,329	5,229	1,682										9,239
2053	2,349	5,274	1,692										9,313
2054	2,369	5,318	1,702										9,391
2055	2,389	5,363	1,712										9,465
2056	2,409	5,408	1,722										9,539
2057	2,430	5,452	1,732										9,614
2058	2,450	5,497	1,742										9,688
2059	2,470	5,542	1,752										9,763
2060	2,490	5,586	1,762										9,837
2061	2,509	5,632	1,772										9,913
2062	2,529	5,678	1,783										9,989
2063	2,549	5,723	1,794										10,066
2064	2,569	5,769	1,804										10,142
2065	2,589	5,814	1,815										10,218
2066	2,609	5,860	1,826										10,294
2067	2,629	5,906	1,837										10,371
2068	2,649	5,951	1,847										10,447
2069	2,668	5,997	1,858										10,523
2070	2,691	6,042	1,869										10,602

9 Region F Challenges

Listed below are challenges the RFWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout West Texas is relatively low. Traditional municipal conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the RFWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The RFWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The RFWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar future data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Region F are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and RFWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the RFWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region F, the most common suggested activities were to install AMI with a customer engagement portal to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Brazos G Water Planning Group
Region G • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region G make up approximately 1,000,000 in population by 2020, which is 45 percent of the region's total projected 2020 population.
- Participating utilities make up 73 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of 22 participating water utilities in place—and without further enhancement—Region G as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 993 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2070 supply volume by 76,881 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of 22 participating water utilities in place—and without further enhancement—these 22 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 1,890 acre-feet per year.[1]
- Without further activity, these utilities are projected to fall short of their 2022 supply volume by 658 acre-feet per year.
- Of those utilities surveyed, the region averages 2.8 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region G is comprised of all or portions of 31 counties. The area has diverse characteristics that make for a wide variation in water supplies, demands, and availability.

The Brazos G Regional Water Plan states, "[c]onservation in the 2016 Plan is much more aggressively considered than in the 2011 Plan." The plan calls for 96,816 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016f). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.
[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region G are 10,632 acre-feet per year for 2020, 29,914 acre-feet per year for 2030, 46,634 acre-feet per year for 2040, 63,775 acre-feet per year for 2050, and 81,301 acre-feet per year for 2060.

(shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region G, 21 utilities met these criteria and were contacted for participation. All 21 utilities accepted and were included in the results. The City of Waco was also added because it is such a large utility for the region. Below are the 22 participating utilities:

Abilene	Hewitt
Bethesda WSC	Kempner WSC
Brenham	Lampasas
Brushy Creek MUD	Leander
Bryan	Possum Kingdom WSC
Burleson	Robinson
Cedar Park	Round Rock
Chisholm Trail SUD	Sweetwater
College Station	Temple
Georgetown	Waco
Groesbeck	Woodway

These utilities represent approximately 45 percent of the 2020 population of Region G and represent 73 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts. This report summarizes the savings from the individual utility reports within Region G.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

In general, the conservation WMS supply volumes for municipal WUGs reflect a one percent annual reduction in gallons per capita per day (GPCD) until a target of 140 GPCD[3] is reached. More aggressive targets were set for some WUGs in Williamson County.

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

4.2 Approach to Meeting Recommended Supply Volumes

The Brazos G Water Planning Group (BGWPG) recommended achieving conservation goals by using BMPs identified by the Water Conservation Task Force:

- System Water Audit and Water Loss
- Water Conservation Pricing
- Prohibition on Wasting Water
- Showerhead, Aerator, and Toilet Flapper Retrofit
- Residential Toilet Replacement Programs with Ultra-Low-Flow Toilets
- Residential Clothes Washer Incentive Program
- School Education
- Water Survey for Single-Family and Multi-Family Customers
- Landscape Irrigation Conservation and Incentives
- Water-Wise Landscape Design and Conversion Programs
- Athletic Field Conservation
- Golf Course Conservation
- Metering of all New Connections and Retrofitting of Existing Connections
- Wholesale Agency Assistance Programs
- Conservation Coordinator
- Reuse of Reclaimed Water
- Public Information
- Rainwater Harvesting and Condensate Reuse
- New Construction Graywater
- Park Conservation
- Conservation Programs for Industrial, Commercial, and Institutional Accounts.

Savings for these recommendations were not estimated individually, but rather a broad approach was used with guidance from the Task Force and the Texas Commission on Environmental Quality (TCEQ). Savings from landscape irrigation is expected to save 11 GPCD and public education is projected to save three GPCD.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region G. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region G.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
G	21	13	2	2	4	1	1	5	1	4	4	58	2.8

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region G is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process

to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

---

divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.

- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain

volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Brazos G Regional Water Plan recommends that Region G should achieve 96,816 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the 22 participating utilities are estimated to meet goals through 2020. By 2070 these utilities' current savings are estimated to be short of the recommended supply volumes by 50,189 acre-feet per year.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 22 participating utilities. These utilities constitute approximately 45 percent of the region's population and account for 73 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	3,978	1,355	5,333	3,437	8	3,444	1,889
2016	5,762	1,436	7,197	4,296	9	4,305	2,892
2017	7,610	1,517	9,126	4,296	11	4,307	4,819
2018	7,697	1,597	9,295	5,155	13	5,168	4,127
2019	7,787	1,678	9,465	6,012	15	6,028	3,437
2020	7,880	1,759	9,639	7,732	17	7,749	1,890
2021	7,977	1,832	9,809	9,177	17	9,194	615
2022	8,077	1,905	9,981	10,622	17	10,639	(658)
2023	8,175	1,977	10,152	12,067	17	12,084	(1,932)
2024	8,270	2,050	10,320	13,512	17	13,529	(3,209)
2025	8,364	2,123	10,487	14,957	17	14,974	(4,487)
2026	8,460	2,196	10,656	16,402	17	16,419	(5,763)
2027	8,560	2,269	10,829	17,847	17	17,864	(7,035)
2028	8,660	2,341	11,001	19,292	17	19,309	(8,308)
2029	8,759	2,414	11,174	20,737	17	20,754	(9,580)
2030	8,859	2,487	11,346	22,182	17	22,199	(10,853)
2031	8,973	2,563	11,536	23,460	16	23,476	(11,940)
2032	9,087	2,640	11,727	24,738	15	24,753	(13,027)
2033	9,201	2,716	11,917	26,017	14	26,031	(14,114)
2034	9,315	2,793	12,108	27,295	13	27,308	(15,201)
2035	9,429	2,869	12,298	28,574	12	28,586	(16,288)
2036	9,543	2,945	12,489	29,852	11	29,863	(17,375)
2037	9,657	3,022	12,679	31,131	10	31,141	(18,462)
2038	9,771	3,098	12,869	32,409	9	32,418	(19,549)
2039	9,885	3,175	13,060	33,688	8	33,696	(20,636)
2040	9,999	3,251	13,250	34,966	7	34,973	(21,723)
2041	10,123	3,342	13,464	36,307	7	36,314	(22,850)
2042	10,246	3,432	13,678	37,648	7	37,655	(23,976)
2043	10,370	3,523	13,893	38,989	7	38,996	(25,103)
2044	10,493	3,613	14,107	40,330	7	40,337	(26,230)
2045	10,617	3,704	14,321	41,671	7	41,678	(27,357)
2046	10,740	3,794	14,535	43,012	7	43,019	(28,484)
2047	10,864	3,885	14,749	44,353	7	44,360	(29,611)
2048	10,987	3,976	14,963	45,694	7	45,701	(30,738)
2049	11,111	4,066	15,177	47,035	7	47,042	(31,865)
2050	11,234	4,157	15,391	48,376	7	48,383	(32,992)
2051	11,352	4,261	15,613	49,596	7	49,603	(33,990)
2052	11,470	4,365	15,835	50,816	7	50,823	(34,988)
2053	11,588	4,470	16,057	52,037	7	52,044	(35,986)
2054	11,706	4,574	16,279	53,257	7	53,264	(36,985)
2055	11,824	4,678	16,502	54,477	7	54,484	(37,983)
2056	11,941	4,782	16,724	55,698	7	55,705	(38,981)
2057	12,059	4,886	16,946	56,918	7	56,925	(39,979)
2058	12,177	4,991	17,168	58,138	7	58,145	(40,977)
2059	12,295	5,095	17,390	59,358	7	59,365	(41,976)
2060	12,413	5,199	17,612	60,579	7	60,586	(42,974)
2061	12,536	5,308	17,844	61,533	7	61,540	(43,695)
2062	12,659	5,417	18,077	62,486	7	62,493	(44,417)
2063	12,783	5,526	18,309	63,440	7	63,447	(45,138)
2064	12,906	5,635	18,541	64,394	7	64,401	(45,860)
2065	13,030	5,744	18,774	65,348	7	65,355	(46,581)
2066	13,153	5,853	19,006	66,302	7	66,309	(47,303)
2067	13,276	5,962	19,238	67,256	7	67,263	(48,024)
2068	13,400	6,071	19,471	68,209	7	68,216	(48,746)
2069	13,523	6,180	19,703	69,163	7	69,170	(49,467)
2070	13,646	6,289	19,935	70,117	7	70,124	(50,189)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
G	Meeting	11	6,364	6	3,927	5	3,968	4	3,434	4	3,976	4	4,557
	Not Meeting	10	(4,474)	15	(14,780)	16	(25,691)	17	(36,426)	17	(46,950)	17	(54,737)
	Total Region G	21	1,890	21	(10,853)	21	(21,723)	21	(32,992)	21	(42,974)	21	(50,189)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	3,978	1,355	5,333	4,725	608
2016	5,762	1,436	7,197	5,907	1,291
2017	7,610	1,517	9,126	5,907	3,220
2018	7,697	1,597	9,295	7,088	2,207
2019	7,787	1,678	9,465	8,269	1,195
2020	7,880	1,759	9,639	10,632	(993)
2021	7,977	1,832	9,809	12,560	(2,751)
2022	8,077	1,905	9,981	14,488	(4,507)
2023	8,175	1,977	10,152	16,417	(6,264)
2024	8,270	2,050	10,320	18,345	(8,025)
2025	8,364	2,123	10,487	20,273	(9,786)
2026	8,460	2,196	10,656	22,201	(11,545)
2027	8,560	2,269	10,829	24,129	(13,301)
2028	8,660	2,341	11,001	26,058	(15,056)
2029	8,759	2,414	11,174	27,986	(16,812)
2030	8,859	2,487	11,346	29,914	(18,568)
2031	8,973	2,563	11,536	31,586	(20,050)
2032	9,087	2,640	11,727	33,258	(21,531)
2033	9,201	2,716	11,917	34,930	(23,013)
2034	9,315	2,793	12,108	36,602	(24,494)
2035	9,429	2,869	12,298	38,274	(25,976)
2036	9,543	2,945	12,489	39,946	(27,457)
2037	9,657	3,022	12,679	41,618	(28,939)
2038	9,771	3,098	12,869	43,290	(30,421)
2039	9,885	3,175	13,060	44,962	(31,902)
2040	9,999	3,251	13,250	46,634	(33,384)
2041	10,123	3,342	13,464	48,348	(34,884)
2042	10,246	3,432	13,678	50,062	(36,384)
2043	10,370	3,523	13,893	51,776	(37,884)
2044	10,493	3,613	14,107	53,490	(39,384)
2045	10,617	3,704	14,321	55,205	(40,884)
2046	10,740	3,794	14,535	56,919	(42,384)
2047	10,864	3,885	14,749	58,633	(43,884)
2048	10,987	3,976	14,963	60,347	(45,384)
2049	11,111	4,066	15,177	62,061	(46,884)
2050	11,234	4,157	15,391	63,775	(48,384)
2051	11,352	4,261	15,613	65,528	(49,914)
2052	11,470	4,365	15,835	67,280	(51,445)
2053	11,588	4,470	16,057	69,033	(52,975)
2054	11,706	4,574	16,279	70,785	(54,506)
2055	11,824	4,678	16,502	72,538	(56,036)
2056	11,941	4,782	16,724	74,291	(57,567)
2057	12,059	4,886	16,946	76,043	(59,098)
2058	12,177	4,991	17,168	77,796	(60,628)
2059	12,295	5,095	17,390	79,548	(62,159)
2060	12,413	5,199	17,612	81,301	(63,689)
2061	12,536	5,308	17,844	82,853	(65,008)
2062	12,659	5,417	18,077	84,404	(66,327)
2063	12,783	5,526	18,309	85,956	(67,647)
2064	12,906	5,635	18,541	87,507	(68,966)
2065	13,030	5,744	18,774	89,059	(70,285)
2066	13,153	5,853	19,006	90,610	(71,604)
2067	13,276	5,962	19,238	92,162	(72,923)
2068	13,400	6,071	19,471	93,713	(74,242)
2069	13,523	6,180	19,703	95,265	(75,562)
2070	13,646	6,289	19,935	96,816	(76,881)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	1,355	1,218	1,668	925		20	20		13		102	12	5,333
2016	1,436	2,717	1,688	940		24	15	38	14		113	203	7,197
2017	1,517	4,263	1,708	956	260	17	10	38	14		113	228	9,126
2018	1,597	4,299	1,728	971	262	13	5	38	14		113	254	9,295
2019	1,678	4,335	1,748	987	265	6	2	38	14		113	279	9,465
2020	1,759	4,372	1,768	1,003	267	2		38	14		113	304	9,639
2021	1,832	4,408	1,788	1,018	270			38	14		113	329	9,809
2022	1,905	4,444	1,809	1,034	273			38	14		113	354	9,981
2023	1,977	4,480	1,829	1,050	275			38	13		113	379	10,152
2024	2,050	4,517	1,849	1,065	278			38	8		113	404	10,320
2025	2,123	4,553	1,869	1,081	280			38	2		113	429	10,487
2026	2,196	4,589	1,889	1,096	283			38			113	454	10,656
2027	2,269	4,625	1,909	1,112	285			38			113	479	10,829
2028	2,341	4,661	1,929	1,128	288			38			113	504	11,001
2029	2,414	4,698	1,949	1,143	291			38			113	529	11,174
2030	2,487	4,734	1,970	1,159	293			38			113	554	11,346
2031	2,563	4,773	1,979	1,187	293			38			113	592	11,536
2032	2,640	4,812	1,988	1,216	294			38			113	629	11,727
2033	2,716	4,851	1,997	1,244	294			38			113	666	11,917
2034	2,793	4,891	2,006	1,273	294			38			113	703	12,108
2035	2,869	4,930	2,015	1,301	294			38			113	740	12,298
2036	2,945	4,969	2,024	1,329	294			38			113	778	12,489
2037	3,022	5,008	2,033	1,358	294			38			113	815	12,679
2038	3,098	5,047	2,042	1,386	295			38			113	852	12,869
2039	3,175	5,087	2,051	1,415	295			38			113	889	13,060
2040	3,251	5,126	2,060	1,443	295			38			113	926	13,250
2041	3,342	5,169	2,069	1,471	295			38			113	970	13,464
2042	3,432	5,211	2,078	1,499	295			38			113	1,015	13,678
2043	3,523	5,254	2,087	1,526	295			38			113	1,059	13,893
2044	3,613	5,297	2,096	1,554	295			38			113	1,103	14,107
2045	3,704	5,340	2,104	1,582	295			38			113	1,147	14,321
2046	3,794	5,383	2,113	1,609	295			38			113	1,192	14,535
2047	3,885	5,425	2,122	1,637	294			38			113	1,236	14,749
2048	3,976	5,468	2,131	1,665	294			38			113	1,280	14,963
2049	4,066	5,511	2,140	1,693	294			38			113	1,324	15,177
2050	4,157	5,554	2,148	1,720	294			38			113	1,369	15,391
2051	4,261	5,601	2,158	1,752	294			38			113	1,399	15,613
2052	4,365	5,647	2,168	1,783	294			38			113	1,429	15,835
2053	4,470	5,694	2,177	1,814	294			38			113	1,459	16,057
2054	4,574	5,741	2,187	1,845	294			38			113	1,489	16,279
2055	4,678	5,788	2,197	1,877	294			38			113	1,519	16,502
2056	4,782	5,835	2,206	1,908	294			38			113	1,549	16,724
2057	4,886	5,882	2,216	1,939	294			38			113	1,579	16,946
2058	4,991	5,929	2,226	1,971	294			38			113	1,609	17,168
2059	5,095	5,975	2,235	2,002	294			38			113	1,639	17,390
2060	5,199	6,022	2,245	2,033	294			38			113	1,669	17,612
2061	5,308	6,069	2,255	2,066	294			38			113	1,702	17,844
2062	5,417	6,117	2,266	2,099	294			38			113	1,735	18,077
2063	5,526	6,164	2,276	2,132	294			38			113	1,769	18,309
2064	5,635	6,211	2,286	2,165	294			38			113	1,802	18,541
2065	5,744	6,258	2,296	2,198	294			38			113	1,835	18,774
2066	5,853	6,305	2,307	2,230	294			38			113	1,868	19,006
2067	5,962	6,352	2,317	2,263	294			38			113	1,901	19,238
2068	6,071	6,399	2,327	2,296	294			38			113	1,934	19,471
2069	6,180	6,446	2,337	2,329	294			38			113	1,967	19,703
2070	6,289	6,494	2,348	2,362	294			38			113	2,001	19,935

9 Region G Challenges

Listed below are challenges the BGWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout the region is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the BGWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The BGWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The BGWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Region G are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and BGWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the BGWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE

offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region G, the most common suggested activities were to install AMI with customer engagement portals to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption. The implementation of twice-per-week watering restrictions also have the potential to save large quantities of water with relatively low overhead cost for utilities.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Region H Water Planning Group • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region H make up approximately 3,300,000 in population by 2020, which is 45 percent of the region's total projected 2020 population.
- Participating utilities make up 62 percent of the region's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of 21 participating water utilities in place—and without further enhancement—Region H as a whole is projected

to exceed its recommended 2020 water conservation supply volume by 18,761 acre-feet per year.

- These conservation savings estimates will fall short of the region's 2027 supply volume by 433 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of 21 participating water utilities in place—and without further enhancement—these 21 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 26,489 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2037 supply volume by acre-feet per year, but will fall short of their 2070 volume by 34,962 acre-feet per year.
- Of those utilities surveyed, the region averages 3.1 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region H encompasses all or part of 15 counties in southeast Texas and includes the majority of the San Jacinto River Basin and the lower reaches of the Brazos and Trinity River Basins. The area is generally characterized by urbanized land use and broad-based economic development. In areas outside of the urban core, agriculture dominates economic activity. Large numbers of municipal utility districts (MUDs) also make this region unique.

The Region H Plan states, "[w]ater conservation has always been a key component of the Region H Water Planning Group (RHWPG). For the development of the 2016 [Regional Water Plan], the RHWPG expanded municipal conservation to consider both water loss reduction and the application of other advanced methods in addition to the baseline conservation applied by TWDB." The plan calls for 150,660 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016g). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region H are 20,364 acre-feet per year for 2020, 49,637 acre-feet per year for 2030, 78,442 acre-feet per year for 2040, 107,062 acre-feet per year for 2050, and 129,016 acre-feet per year for 2060.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region H, 33 utilities met these criteria and were contacted for participation. Out of the 33, 14 utilities accepted and were included in the results. In order to get a more accurate scope of conservation data, Deer Park, Friendswood, Galveston, Huntsville, Pearland, Stafford (Fort Bend County WCID #2), The Woodlands, and Lake Jackson were also included. Below are the participating utilities:

Baytown	Humble	Pearland
Clute	Huntsville	Southern Montgomery Cty. MUD
Conroe	Jersey Village	Stafford
Deer Park	Katy	Sugarland
Friendswood	Lake Jackson	The Woodlands
Galveston	League City	West University Place
Houston	Pasadena	Willis

These utilities represent approximately 45 percent of the 2020 population of Region H and represent 62 percent of the 2020 WMS supply volume for municipal water conservation for the region.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more

- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

"Region H focuses much of its conservation resources towards outreach, conservation rates, and water system audits, leak detection, and repair" (Texas Water Development Board, 2016g).

The Region H planners incorporated a "bottom-up" study into its approach to estimate potential savings from advanced conservation activities. By doing so, the plan noted that if ordinances limiting outdoor watering to twice per week (or less) were implemented, that measure alone could produce enough savings to meet supply volumes well into the planning period.

Advanced water conservation strategies recommended in the Region H Plan include:

- Residential high-efficiency toilet rebates for single-family households

- Residential low-flow showerhead replacement for single-family households
- Kitchen pre-rinse spray valve replacement for commercial-industrial-institutional customers
- Cooling tower modifications for commercial-industrial-institutional customers
- Tank-type high-efficiency toilet replacement for commercial-industrial-institutional customers
- Large landscape water budgets for commercial-industrial-institutional or single-family customers

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region H. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region H.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
H	21	10	2	4	1	15	3	3	3	2	2	66	3.1

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region H is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility’s baseline.

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting its Municipal Conservation Supply Volumes?

The 2016 Region H Water Plan recommends that Region H should achieve 150,660 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the 21 utilities surveyed in this region are estimated to achieve recommended supply volumes through the year 2038. Beyond that, they will need to employ sufficient activities to cover the 34,962 acre-feet per year deficit that will accrue by the year 2070. The non-participating municipal WUGs have a recommended WMS supply volume for municipal conservation of 62,970 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 21 participating utilities. These utilities constitute approximately 45 percent of the region's population and account for 62 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

---

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	18,599	15,344	33,944	2,173	3,443	5,616	28,328
2016	20,632	15,479	36,110	2,717	4,303	7,020	29,090
2017	23,562	15,655	39,217	2,717	5,164	7,881	31,336
2018	23,446	15,832	39,278	3,260	6,025	9,285	29,993
2019	23,314	15,872	39,187	3,803	6,885	10,689	28,498
2020	23,212	15,913	39,125	4,890	7,746	12,636	26,489
2021	23,114	15,958	39,072	5,848	8,520	14,368	24,704
2022	23,246	16,002	39,248	6,806	9,294	16,100	23,148
2023	23,376	16,046	39,422	7,764	10,068	17,832	21,590
2024	23,505	16,164	39,668	8,722	10,842	19,564	20,104
2025	23,638	16,281	39,919	9,680	11,616	21,296	18,623
2026	23,770	16,399	40,169	10,638	12,390	23,028	17,141
2027	23,906	16,516	40,422	11,596	13,164	24,760	15,662
2028	24,040	16,634	40,674	12,554	13,938	26,492	14,182
2029	24,174	16,752	40,926	13,512	14,712	28,224	12,702
2030	24,308	16,869	41,178	14,470	15,486	29,956	11,222
2031	24,448	16,986	41,434	15,415	16,252	31,667	9,766
2032	24,588	17,102	41,690	16,360	17,019	33,378	8,311
2033	24,728	17,218	41,945	17,304	17,785	35,090	6,856
2034	24,867	17,337	42,204	18,249	18,552	36,801	5,403
2035	25,010	17,456	42,466	19,194	19,318	38,512	3,954
2036	25,150	17,575	42,724	20,139	20,084	40,223	2,501
2037	25,290	17,694	42,983	21,084	20,851	41,934	1,049
2038	25,429	17,812	43,242	22,028	21,617	43,646	(404)
2039	25,569	17,931	43,500	22,973	22,384	45,357	(1,856)
2040	25,709	18,050	43,759	23,918	23,150	47,068	(3,309)
2041	25,864	18,168	44,032	24,905	23,890	48,795	(4,763)
2042	26,017	18,285	44,302	25,892	24,630	50,522	(6,220)
2043	26,167	18,403	44,569	26,879	25,370	52,249	(7,680)
2044	26,316	18,523	44,839	27,866	26,110	53,976	(9,138)
2045	26,469	18,642	45,111	28,853	26,851	55,704	(10,593)
2046	26,621	18,762	45,383	29,840	27,591	57,431	(12,048)
2047	26,774	18,881	45,655	30,827	28,331	59,158	(13,503)
2048	26,929	19,001	45,930	31,814	29,071	60,885	(14,955)
2049	27,079	19,120	46,199	32,801	29,811	62,612	(16,413)
2050	27,231	19,240	46,471	33,788	30,551	64,339	(17,868)
2051	27,409	19,360	46,769	34,726	30,797	65,522	(18,753)
2052	27,584	19,480	47,064	35,663	31,042	66,706	(19,642)
2053	27,758	19,600	47,358	36,601	31,288	67,889	(20,530)
2054	27,933	19,729	47,662	37,538	31,534	69,072	(21,410)
2055	28,111	19,857	47,968	38,476	31,780	70,256	(22,287)
2056	28,285	19,986	48,272	39,414	32,025	71,439	(23,167)
2057	28,460	20,115	48,575	40,351	32,271	72,622	(24,047)
2058	28,635	20,244	48,878	41,289	32,517	73,805	(24,927)
2059	28,815	20,372	49,188	42,226	32,762	74,989	(25,801)
2060	28,990	20,501	49,491	43,164	33,008	76,172	(26,681)
2061	29,179	20,630	49,809	44,107	33,217	77,324	(27,515)
2062	29,364	20,759	50,123	45,049	33,426	78,476	(28,352)
2063	29,553	20,889	50,441	45,992	33,636	79,627	(29,186)
2064	29,744	21,026	50,770	46,934	33,845	80,779	(30,009)
2065	29,929	21,164	51,093	47,877	34,054	81,931	(30,838)
2066	30,121	21,302	51,423	48,820	34,263	83,083	(31,660)
2067	30,310	21,439	51,749	49,762	34,472	84,235	(32,486)
2068	30,498	21,577	52,075	50,705	34,682	85,386	(33,311)
2069	30,686	21,715	52,401	51,647	34,891	86,538	(34,137)
2070	30,875	21,853	52,728	52,590	35,100	87,690	(34,962)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
H	Meeting	18	27,208	14	14,249	14	13,040	10	12,251	10	12,455	9	12,946
	Not Meeting	3	(719)	7	(3,027)	7	(16,349)	11	(30,119)	11	(39,136)	12	(47,908)
	Total Region H	21	26,489	21	11,222	21	(3,309)	21	(17,868)	21	(26,681)	21	(34,962)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	18,599	15,344	33,944	9,051	24,893
2016	20,632	15,479	36,110	11,313	24,797
2017	23,562	15,655	39,217	11,313	27,904
2018	23,446	15,832	39,278	13,576	25,702
2019	23,314	15,872	39,187	15,839	23,348
2020	23,212	15,913	39,125	20,364	18,761
2021	23,114	15,958	39,072	23,291	15,781
2022	23,246	16,002	39,248	26,219	13,029
2023	23,376	16,046	39,422	29,146	10,276
2024	23,505	16,164	39,668	32,073	7,595
2025	23,638	16,281	39,919	35,001	4,918
2026	23,770	16,399	40,169	37,928	2,241
2027	23,906	16,516	40,422	40,855	(433)
2028	24,040	16,634	40,674	43,782	(3,108)
2029	24,174	16,752	40,926	46,710	(5,784)
2030	24,308	16,869	41,178	49,637	(8,459)
2031	24,448	16,986	41,434	52,518	(11,084)
2032	24,588	17,102	41,690	55,398	(13,708)
2033	24,728	17,218	41,945	58,279	(16,334)
2034	24,867	17,337	42,204	61,159	(18,955)
2035	25,010	17,456	42,466	64,040	(21,574)
2036	25,150	17,575	42,724	66,920	(24,196)
2037	25,290	17,694	42,983	69,801	(26,818)
2038	25,429	17,812	43,242	72,681	(29,439)
2039	25,569	17,931	43,500	75,562	(32,062)
2040	25,709	18,050	43,759	78,442	(34,683)
2041	25,864	18,168	44,032	81,304	(37,272)
2042	26,017	18,285	44,302	84,166	(39,864)
2043	26,167	18,403	44,569	87,028	(42,459)
2044	26,316	18,523	44,839	89,890	(45,051)
2045	26,469	18,642	45,111	92,752	(47,641)
2046	26,621	18,762	45,383	95,614	(50,231)
2047	26,774	18,881	45,655	98,476	(52,821)
2048	26,929	19,001	45,930	101,338	(55,408)
2049	27,079	19,120	46,199	104,200	(58,001)
2050	27,231	19,240	46,471	107,062	(60,591)
2051	27,409	19,360	46,769	109,257	(62,488)
2052	27,584	19,480	47,064	111,453	(64,389)
2053	27,758	19,600	47,358	113,648	(66,290)
2054	27,933	19,729	47,662	115,844	(68,182)
2055	28,111	19,857	47,968	118,039	(70,071)
2056	28,285	19,986	48,272	120,234	(71,962)
2057	28,460	20,115	48,575	122,430	(73,855)
2058	28,635	20,244	48,878	124,625	(75,747)
2059	28,815	20,372	49,188	126,821	(77,633)
2060	28,990	20,501	49,491	129,016	(79,525)
2061	29,179	20,630	49,809	131,180	(81,371)
2062	29,364	20,759	50,123	133,345	(83,222)
2063	29,553	20,889	50,441	135,509	(85,068)
2064	29,744	21,026	50,770	137,674	(86,904)
2065	29,929	21,164	51,093	139,838	(88,745)
2066	30,121	21,302	51,423	142,002	(90,579)
2067	30,310	21,439	51,749	144,167	(92,418)
2068	30,498	21,577	52,075	146,331	(94,256)
2069	30,686	21,715	52,401	148,496	(96,095)
2070	30,875	21,853	52,728	150,660	(97,932)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	15,348	6,961	3,474	1,390	5,443		1,159	102	10	61			33,947
2016	15,482	8,909	3,508	1,404	5,475		1,164	102	12	59			36,113
2017	15,658	11,990	3,541	1,418	5,507		948	102	13	40		3	39,220
2018	15,835	12,044	3,575	1,433	5,539		711	102	13	24		6	39,281
2019	15,876	12,098	3,608	1,447	5,571		457	102	13	12		6	39,190
2020	15,916	12,153	3,642	1,462	5,602		228	102	13	4		6	39,128
2021	15,961	12,207	3,675	1,476	5,634			102	13			6	39,075
2022	16,005	12,261	3,709	1,490	5,666			102	11			6	39,251
2023	16,048	12,316	3,742	1,505	5,698			102	10			3	39,424
2024	16,165	12,370	3,776	1,519	5,730			102	8				39,670
2025	16,283	12,428	3,809	1,534	5,762			102	3				39,921
2026	16,401	12,482	3,843	1,548	5,794			102	1				40,171
2027	16,518	12,539	3,876	1,562	5,826			102					40,424
2028	16,636	12,594	3,910	1,577	5,858			102					40,676
2029	16,753	12,648	3,943	1,591	5,890			102					40,928
2030	16,871	12,703	3,977	1,606	5,921			102					41,179
2031	16,987	12,763	4,010	1,619	5,955			102					41,435
2032	17,103	12,823	4,043	1,632	5,988			102					41,691
2033	17,220	12,884	4,076	1,645	6,021			102					41,947
2034	17,339	12,944	4,108	1,658	6,055			102					42,206
2035	17,458	13,008	4,141	1,671	6,088			102					42,468
2036	17,577	13,068	4,174	1,684	6,121			102					42,726
2037	17,695	13,129	4,207	1,697	6,155			102					42,985
2038	17,814	13,189	4,240	1,710	6,188			102					43,244
2039	17,933	13,249	4,273	1,724	6,221			102					43,502
2040	18,052	13,310	4,306	1,737	6,254			102					43,761
2041	18,170	13,382	4,340	1,749	6,292			102					44,034
2042	18,287	13,451	4,373	1,762	6,329			102					44,304
2043	18,405	13,517	4,407	1,775	6,366			102					44,571
2044	18,525	13,583	4,441	1,787	6,403			102					44,841
2045	18,644	13,652	4,474	1,800	6,440			102					45,113
2046	18,764	13,721	4,508	1,813	6,477			102					45,385
2047	18,883	13,790	4,542	1,825	6,515			102					45,657
2048	19,003	13,862	4,575	1,838	6,552			102					45,932
2049	19,122	13,928	4,609	1,851	6,589			102					46,201
2050	19,242	13,997	4,643	1,864	6,626			102					46,473
2051	19,362	14,077	4,685	1,877	6,668			102					46,771
2052	19,482	14,154	4,726	1,891	6,710			102					47,066
2053	19,602	14,231	4,768	1,905	6,752			102					47,361
2054	19,731	14,307	4,810	1,919	6,794			102					47,664
2055	19,860	14,387	4,852	1,933	6,836			102					47,970
2056	19,988	14,464	4,894	1,947	6,878			102					48,274
2057	20,117	14,541	4,936	1,961	6,921			102					48,577
2058	20,246	14,618	4,978	1,975	6,963			102					48,880
2059	20,374	14,701	5,020	1,988	7,005			102					49,190
2060	20,503	14,778	5,061	2,002	7,047			102					49,493
2061	20,632	14,859	5,109	2,017	7,091			102					49,811
2062	20,761	14,937	5,157	2,032	7,136			102					50,126
2063	20,891	15,019	5,204	2,047	7,181			102					50,443
2064	21,028	15,103	5,252	2,062	7,225			102					50,773
2065	21,166	15,181	5,299	2,077	7,270			102					51,096
2066	21,304	15,266	5,347	2,092	7,315			102					51,425
2067	21,442	15,347	5,394	2,107	7,359			102					51,751
2068	21,579	15,428	5,442	2,122	7,404			102					52,077
2069	21,717	15,510	5,490	2,137	7,449			102					52,403
2070	21,852	15,591	5,537	2,152	7,493			102					52,727

9 Region H Challenges

Listed below are challenges the RHWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group that specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.
- There are hundreds of MUDs within Region H. The project struggled to establish an efficient communication link with MUD boards of directors. It will be crucial in the future to include this large population in studies and implementation efforts in order to meet the regional WMS supply volume for municipal conservation.

9.2 Teamwork and Accomplishment

There are many utilities within Region H that are unaware of their portion of the recommended WMS supply volume for municipal conservation. There is a general feeling among wholesale water customers of the City of Houston that any effort they make would be insignificant compared to the city's efforts.

By educating these communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could develop a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the RHWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The RHWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. For this project, each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The RHWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar future data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in the Region H are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and RHWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the RHWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region H, the most common suggested activities were to install AMI with customer engagement portals to help reduce water loss and inform customers about their water use patterns. Use of periodic, strategic water rate increases to reduce consumption is an ongoing effective activity. Twice-per-week watering ordinances also have the potential for large savings in this region.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Plateau Regional Water Planning Group
Region J • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region J make up approximately 60,000 in population by 2020, which is 43 percent of the region's total projected 2020 population.
- Participating utilities make up 74 percent of the region's recommended 2020 municipal conservation goal (supply volume).
- With the current conservation activities of two participating water utilities in place—and without further enhancement—Region J as a whole is projected to

exceed its recommended 2020 water conservation supply volume by 1,046 acre-feet per year.

- With the current conservation activities of two participating water utilities in place—and without further enhancement—these two utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 1,137 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 1,598 acre-feet per year.
- Of those utilities surveyed, the region averages 1.5 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region J is a five-county area that stretches from the Central Texas Hill Country westward to the Rio Grande River. It is a sparsely populated, arid, agricultural region. It is not considered a rapid-growth area of Texas.

The Region J Plan states, "[w]ater conservation is one of the most important components of water supply management. Recognizing its impact, setting realistic goals, and aggressively enforcing implementation may significantly extend the time when new supplies and associated infrastructure are needed." The plan calls for 358 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016h). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region J are 357 acre-feet per year for 2020, 357 acre-feet per year for 2030, 357 acre-feet per year for 2040, 358 acre-feet per year for 2050, and 358 acre-feet per year for 2060.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region J, no WUGs met the criteria. In order to gain valuable insight about water conservation in Region J, Del Rio and Kerrville were contacted, agreed to participate and were included in the results.

These utilities represent approximately 43 percent of the 2020 population of Region J and 74 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts. This report summarizes the savings from the individual utility reports within Region J.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When

WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Meeting Recommended Supply Volumes

Water conservation strategies recommended in the Region J Plan include:

- Water loss audits
- Public education
- Brush management
- Rainwater harvesting (as an alternate strategy)

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region J. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region J.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
J	2	1	0	0	0	0	0	0	0	0	0	3	1.5

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately to ensure Region J is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

GPCD[4] for that year.[5] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[6] for water loss GPCD[7] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility’s baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

---

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[5] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[6] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.

- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Plateau Region Water Plan recommends that Region J should achieve 358 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the two utilities surveyed in this region are estimated to exceed their portion (266 acre-feet per year) by 1,598 acre-feet per year. The non-participating municipal WUG have a WMS supply volume for municipal conservation of 92 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region’s participating utilities’ quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the two participating utilities. These utilities constitute approximately 43 percent of the region’s population and account for 74 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[8] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	138	1,189	1,327	53	65	118	1,209
2016	138	1,204	1,342	66	82	148	1,194
2017	138	1,219	1,357	66	98	164	1,193
2018	138	1,234	1,373	79	114	194	1,179
2019	138	1,250	1,388	93	131	223	1,165
2020	139	1,265	1,403	119	147	266	1,137
2021	139	1,274	1,412	119	147	266	1,146
2022	139	1,283	1,422	119	147	266	1,156
2023	139	1,291	1,431	119	147	266	1,165
2024	139	1,300	1,440	119	147	266	1,174
2025	140	1,309	1,449	119	147	266	1,183
2026	140	1,318	1,458	119	147	266	1,192
2027	140	1,327	1,467	119	147	266	1,201
2028	140	1,336	1,476	119	147	266	1,210
2029	140	1,345	1,485	119	147	266	1,219
2030	141	1,354	1,495	119	147	266	1,229
2031	141	1,363	1,504	119	147	266	1,238
2032	141	1,372	1,513	119	147	266	1,247
2033	141	1,381	1,522	119	147	266	1,256
2034	141	1,390	1,531	119	147	266	1,265
2035	141	1,399	1,540	119	147	266	1,274
2036	141	1,408	1,549	119	147	266	1,283
2037	141	1,418	1,559	119	147	266	1,293
2038	141	1,427	1,568	119	147	266	1,302
2039	141	1,436	1,577	119	147	266	1,311
2040	141	1,445	1,586	119	147	266	1,320
2041	141	1,454	1,595	119	147	266	1,329
2042	141	1,463	1,605	119	147	266	1,339
2043	142	1,473	1,614	119	147	266	1,348
2044	142	1,482	1,624	119	147	266	1,358
2045	142	1,492	1,634	119	147	266	1,368
2046	142	1,501	1,643	119	147	266	1,377
2047	142	1,510	1,653	119	147	266	1,387
2048	142	1,520	1,662	119	147	266	1,396
2049	143	1,529	1,672	119	147	266	1,406
2050	143	1,538	1,681	119	147	266	1,415
2051	143	1,547	1,690	119	147	266	1,424
2052	143	1,557	1,700	119	147	266	1,434
2053	143	1,566	1,709	119	147	266	1,443
2054	144	1,575	1,718	119	147	266	1,452
2055	144	1,584	1,727	119	147	266	1,461
2056	144	1,593	1,737	119	147	266	1,471
2057	144	1,602	1,746	119	147	266	1,480
2058	144	1,611	1,755	119	147	266	1,489
2059	144	1,620	1,764	119	147	266	1,498
2060	145	1,629	1,774	119	147	266	1,508
2061	145	1,638	1,783	119	147	266	1,517
2062	145	1,647	1,792	119	147	266	1,526
2063	145	1,656	1,801	119	147	266	1,535
2064	145	1,665	1,810	119	147	266	1,544
2065	145	1,673	1,819	119	147	266	1,553
2066	146	1,682	1,828	119	147	266	1,562
2067	146	1,691	1,837	119	147	266	1,571
2068	146	1,700	1,846	119	147	266	1,580
2069	146	1,709	1,855	119	147	266	1,589
2070	146	1,718	1,864	119	147	266	1,598

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole..

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
J	Meeting	1	1,461	1	1,559	1	1,657	1	1,758	1	1,853	1	1,948
	Not Meeting	1	(324)	1	(330)	1	(337)	1	(343)	1	(345)	1	(350)
	Total Region J	2	1,137	2	1,229	2	1,320	2	1,415	2	1,508	2	1,598

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	138	1,189	1,327	159	1,168
2016	138	1,204	1,342	198	1,144
2017	138	1,219	1,357	198	1,159
2018	138	1,234	1,373	238	1,135
2019	138	1,250	1,388	278	1,110
2020	139	1,265	1,403	357	1,046
2021	139	1,274	1,412	357	1,055
2022	139	1,283	1,422	357	1,065
2023	139	1,291	1,431	357	1,074
2024	139	1,300	1,440	357	1,083
2025	140	1,309	1,449	357	1,092
2026	140	1,318	1,458	357	1,101
2027	140	1,327	1,467	357	1,110
2028	140	1,336	1,476	357	1,119
2029	140	1,345	1,485	357	1,128
2030	141	1,354	1,495	357	1,138
2031	141	1,363	1,504	357	1,147
2032	141	1,372	1,513	357	1,156
2033	141	1,381	1,522	357	1,165
2034	141	1,390	1,531	357	1,174
2035	141	1,399	1,540	357	1,183
2036	141	1,408	1,549	357	1,192
2037	141	1,418	1,559	357	1,202
2038	141	1,427	1,568	357	1,211
2039	141	1,436	1,577	357	1,220
2040	141	1,445	1,586	357	1,229
2041	141	1,454	1,595	357	1,238
2042	141	1,463	1,605	357	1,248
2043	142	1,473	1,614	357	1,257
2044	142	1,482	1,624	357	1,267
2045	142	1,492	1,634	358	1,276
2046	142	1,501	1,643	358	1,285
2047	142	1,510	1,653	358	1,295
2048	142	1,520	1,662	358	1,304
2049	143	1,529	1,672	358	1,314
2050	143	1,538	1,681	358	1,323
2051	143	1,547	1,690	358	1,332
2052	143	1,557	1,700	358	1,342
2053	143	1,566	1,709	358	1,351
2054	144	1,575	1,718	358	1,360
2055	144	1,584	1,727	358	1,369
2056	144	1,593	1,737	358	1,379
2057	144	1,602	1,746	358	1,388
2058	144	1,611	1,755	358	1,397
2059	144	1,620	1,764	358	1,406
2060	145	1,629	1,774	358	1,416
2061	145	1,638	1,783	358	1,425
2062	145	1,647	1,792	358	1,434
2063	145	1,656	1,801	358	1,443
2064	145	1,665	1,810	358	1,452
2065	145	1,673	1,819	358	1,461
2066	146	1,682	1,828	358	1,470
2067	146	1,691	1,837	358	1,479
2068	146	1,700	1,846	358	1,488
2069	146	1,709	1,855	358	1,497
2070	146	1,718	1,864	358	1,506

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[10] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

---

[10] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	1,189	138											1,327
2016	1,204	138											1,342
2017	1,219	138											1,357
2018	1,234	138											1,373
2019	1,250	138											1,388
2020	1,265	139											1,403
2021	1,274	139											1,412
2022	1,283	139											1,422
2023	1,291	139											1,431
2024	1,300	139											1,440
2025	1,309	140											1,449
2026	1,318	140											1,458
2027	1,327	140											1,467
2028	1,336	140											1,476
2029	1,345	140											1,485
2030	1,354	141											1,495
2031	1,363	141											1,504
2032	1,372	141											1,513
2033	1,381	141											1,522
2034	1,390	141											1,531
2035	1,399	141											1,540
2036	1,408	141											1,549
2037	1,418	141											1,559
2038	1,427	141											1,568
2039	1,436	141											1,577
2040	1,445	141											1,586
2041	1,454	141											1,595
2042	1,463	141											1,605
2043	1,473	142											1,614
2044	1,482	142											1,624
2045	1,492	142											1,634
2046	1,501	142											1,643
2047	1,510	142											1,653
2048	1,520	142											1,662
2049	1,529	143											1,672
2050	1,538	143											1,681
2051	1,547	143											1,690
2052	1,557	143											1,700
2053	1,566	143											1,709
2054	1,575	144											1,718
2055	1,584	144											1,727
2056	1,593	144											1,737
2057	1,602	144											1,746
2058	1,611	144											1,755
2059	1,620	144											1,764
2060	1,629	145											1,774
2061	1,638	145											1,783
2062	1,647	145											1,792
2063	1,656	145											1,801
2064	1,665	145											1,810
2065	1,673	145											1,819
2066	1,682	146											1,828
2067	1,691	146											1,837
2068	1,700	146											1,846
2069	1,709	146											1,855
2070	1,718	146											1,864

9 Region J Challenges

Listed below are challenges the PWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout rural Texas is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt. Region J has shown that small towns can make a big difference. The successes of the two participating utilities are a model for other small towns throughout Texas.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the Plateau Regional Water Planning Group (PRWPG) and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The PRWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The PRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities throughout the state are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and PRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the PRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region J, the most common suggested activities were to install AMI with a customer engagement portal to help reduce water loss and inform customers about their water use patterns and to use periodic, strategic water rate increases to reduce consumption.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project Report to the Lower Colorado Regional Water Planning Group Region K • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region K make up approximately 1,200,000 in population by 2020, which is 72 percent of the region's total projected 2020 population.
- Participating utilities make up 84 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of eight participating water utilities in place—and without further enhancement—Region K as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 7,316 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2037 supply volume by 395 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of eight participating water utilities in place—and without further enhancement—these eight utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 12,448 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 volume by 6,207 acre-feet per year.
- Of those utilities surveyed, the region averages 7.1 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region K consists of all or part of 14 counties roughly consistent with the Lower Colorado River Basin. This is a rapidly growing area that stretches from Central Texas to the Gulf Coast.

The Region K Plan states, "[t]he LCRWPG supports conservation as an important component of water planning. It is more effective and less costly to use less water than to develop new sources." The plan calls for 86,222 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016i). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region K are 31,253 acre-feet per year for 2020, 41,444 acre-feet per year for 2030, 52,373 acre-feet per year for 2040, 62,803 acre-feet per year for 2050, and 73,719 acre-feet per year for 2060.

(shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region K, 10 utilities met these criteria and were contacted for participation. In order to gain valuable insight about water conservation in Region K, Austin was contacted and also agreed to participate. Ultimately, eight utilities accepted and were included in the results:

Austin	Llano
Aqua WSC	Pfugerville
Horseshoe Bay	Travis County WCID #17
Johnson City	West Travis Cty. Public Utility Agency

These utilities represent approximately 72 percent of the 2020 population of Region K and 84 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Note that Leander and Cedar Park receive a substantial portion of their water supply from Region K sources; however, due to regional water planning area boundaries, they are substantially located within Region G Planning Area (Texas Water Development Board, 2015f). Thus, these two participating utilities results are included in the Region G report for this project. See Section 6 for more information on how population and WMS supply volume splits were addressed.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use

- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for conservation, the Region K planners started with targeted goals of 140 GPCD[3] for WUGs within the region. Rates of reduction varied from one percent per year for utilities that had a 2020 GPCD of over 200, and .05 percent per year for those under 200 GPCD (Texas Water Development Board, 2016i)

4.2 Approach to Meeting Recommended Supply Volumes

The Lower Colorado Regional Water Planning Group (LCRWPG) recommends the following conservation strategies (activities):

- Utility water loss and repair initiatives

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- "Smart" meters and AMI
- Customer behavioral engagement software
- Twice-a-week watering
- Landscape standards for new development
- Landscape irrigation evaluations
- Public outreach and education
- TCEQ 344 landscape irrigation standards for new development

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region K. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region K.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
K	8	5	6	2	4	1	0	3	0	4	24	57	7.1

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately on a large scale to ensure Region K is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the colletion of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Lower Colorado Regional Water Plan recommends that Region K should achieve 86,222 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the eight utilities surveyed in this region are estimated to exceed their portion (59,305 acre-feet per year) by 6,207 acre-feet per year by 2070. The non-participating municipal WUGs for the region have a WMS supply volume for municipal conservation of 26,917 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the eight participating utilities. These utilities constitute approximately 72 percent of the region's population and account for 84 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Conservation WMS Volume for Participating Utilities</u> – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

<u>Water Loss Reduction WMS Volume for Participating Utilities</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume for Participating Utilities</u> – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

<u>Over (Short)</u> – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	26,749	(3,088)	23,661	11,609	0	11,609	12,052
2016	38,638	26	38,664	14,512	0	14,512	24,152
2017	38,367	27	38,394	14,512	0	14,512	23,883
2018	37,656	28	37,684	17,414	0	17,414	20,270
2019	38,053	29	38,082	20,316	0	20,316	17,766
2020	38,540	30	38,569	26,121	0	26,121	12,448
2021	39,134	22	39,156	26,683	0	26,683	12,473
2022	39,610	15	39,625	27,245	0	27,245	12,380
2023	40,121	7	40,128	27,807	0	27,807	12,321
2024	40,615	(0)	40,614	28,369	0	28,369	12,245
2025	41,140	(8)	41,133	28,932	0	28,932	12,201
2026	41,713	(15)	41,698	29,494	0	29,494	12,204
2027	42,287	(23)	42,264	30,056	0	30,056	12,208
2028	42,916	(30)	42,885	30,618	0	30,618	12,267
2029	43,544	(38)	43,506	31,180	0	31,180	12,326
2030	44,173	(45)	44,128	31,742	0	31,742	12,386
2031	44,841	(60)	44,781	32,395	0	32,395	12,386
2032	45,510	(75)	45,435	33,049	0	33,049	12,386
2033	46,178	(90)	46,088	33,702	0	33,702	12,386
2034	46,843	(105)	46,739	34,355	0	34,355	12,384
2035	47,512	(119)	47,393	35,009	0	35,009	12,384
2036	48,180	(134)	48,046	35,662	0	35,662	12,384
2037	48,849	(149)	48,700	36,315	0	36,315	12,385
2038	49,514	(164)	49,350	36,968	0	36,968	12,382
2039	50,183	(179)	50,004	37,622	0	37,622	12,382
2040	50,851	(193)	50,658	38,275	0	38,275	12,383
2041	51,386	(218)	51,168	38,884	0	38,884	12,284
2042	51,917	(242)	51,675	39,493	0	39,493	12,183
2043	52,451	(266)	52,186	40,102	0	40,102	12,084
2044	52,986	(290)	52,696	40,711	0	40,711	11,986
2045	53,520	(314)	53,206	41,320	0	41,320	11,887
2046	54,052	(338)	53,714	41,928	0	41,928	11,785
2047	54,586	(362)	54,224	42,537	0	42,537	11,687
2048	55,121	(386)	54,735	43,146	0	43,146	11,588
2049	55,655	(410)	55,245	43,755	0	43,755	11,490
2050	56,187	(434)	55,752	44,392	0	44,392	11,388
2051	56,672	(465)	56,207	45,014	0	45,014	11,192
2052	57,158	(496)	56,661	45,665	0	45,665	10,997
2053	57,640	(527)	57,113	46,315	0	46,315	10,798
2054	58,126	(559)	57,567	46,966	0	46,966	10,602
2055	58,608	(590)	58,019	47,616	0	47,616	10,403
2056	59,094	(621)	58,473	48,266	0	48,266	10,207
2057	59,576	(652)	58,925	48,917	0	48,917	10,008
2058	60,062	(683)	59,379	49,567	0	49,567	9,812
2059	60,545	(714)	59,831	50,218	0	50,218	9,613
2060	61,030	(745)	60,285	50,894	0	50,894	9,417
2061	61,593	(786)	60,808	51,712	0	51,712	9,096
2062	62,157	(827)	61,330	52,555	0	52,555	8,774
2063	62,720	(869)	61,852	53,399	0	53,399	8,453
2064	63,284	(910)	62,374	54,243	0	54,243	8,131
2065	63,850	(951)	62,899	55,087	0	55,087	7,812
2066	64,413	(992)	63,421	55,930	0	55,930	7,491
2067	64,977	(1,034)	63,943	56,774	0	56,774	7,169
2068	65,540	(1,075)	64,465	57,618	0	57,618	6,847
2069	66,103	(1,116)	64,987	58,461	0	58,461	6,526
2070	66,670	(1,158)	65,512	59,305	0	59,305	6,207

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
K	Meeting	4	14,513	2	17,241	2	19,681	2	21,587	2	23,320	2	25,358
	Not Meeting	4	(2,065)	6	(4,855)	6	(7,298)	6	(10,199)	6	(13,903)	6	(19,151)
	Total Region K	8	12,448	8	12,386	8	12,383	8	11,388	8	9,417	8	6,207

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Total Regional WMS Volume</u> – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

<u>Unaccounted for Conservation WMS Volume</u> – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	26,749	(3,088)	23,661	13,890	9,771
2016	38,638	26	38,664	17,363	21,301
2017	38,367	27	38,394	17,363	21,032
2018	37,656	28	37,684	20,835	16,849
2019	38,053	29	38,082	24,308	13,774
2020	38,540	30	38,569	31,253	7,316
2021	39,134	22	39,156	32,272	6,884
2022	39,610	15	39,625	33,291	6,334
2023	40,121	7	40,128	34,310	5,818
2024	40,615	(0)	40,614	35,329	5,285
2025	41,140	(8)	41,133	36,349	4,784
2026	41,713	(15)	41,698	37,368	4,330
2027	42,287	(23)	42,264	38,387	3,877
2028	42,916	(30)	42,885	39,406	3,479
2029	43,544	(38)	43,506	40,425	3,081
2030	44,173	(45)	44,128	41,444	2,684
2031	44,841	(60)	44,781	42,537	2,244
2032	45,510	(75)	45,435	43,630	1,805
2033	46,178	(90)	46,088	44,723	1,366
2034	46,843	(105)	46,739	45,816	923
2035	47,512	(119)	47,393	46,909	484
2036	48,180	(134)	48,046	48,001	45
2037	48,849	(149)	48,700	49,094	(395)
2038	49,514	(164)	49,350	50,187	(837)
2039	50,183	(179)	50,004	51,280	(1,276)
2040	50,851	(193)	50,658	52,373	(1,715)
2041	51,386	(218)	51,168	53,416	(2,248)
2042	51,917	(242)	51,675	54,459	(2,784)
2043	52,451	(266)	52,186	55,502	(3,316)
2044	52,986	(290)	52,696	56,545	(3,849)
2045	53,520	(314)	53,206	57,588	(4,382)
2046	54,052	(338)	53,714	58,631	(4,917)
2047	54,586	(362)	54,224	59,674	(5,450)
2048	55,121	(386)	54,735	60,717	(5,982)
2049	55,655	(410)	55,245	61,760	(6,515)
2050	56,187	(434)	55,752	62,803	(7,051)
2051	56,672	(465)	56,207	63,895	(7,688)
2052	57,158	(496)	56,661	64,986	(8,325)
2053	57,640	(527)	57,113	66,078	(8,965)
2054	58,126	(559)	57,567	67,169	(9,602)
2055	58,608	(590)	58,019	68,261	(10,242)
2056	59,094	(621)	58,473	69,353	(10,879)
2057	59,576	(652)	58,925	70,444	(11,519)
2058	60,062	(683)	59,379	71,536	(12,156)
2059	60,545	(714)	59,831	72,627	(12,796)
2060	61,030	(745)	60,285	73,719	(13,434)
2061	61,593	(786)	60,808	74,969	(14,162)
2062	62,157	(827)	61,330	76,220	(14,890)
2063	62,720	(869)	61,852	77,470	(15,618)
2064	63,284	(910)	62,374	78,720	(16,346)
2065	63,850	(951)	62,899	79,971	(17,072)
2066	64,413	(992)	63,421	81,221	(17,800)
2067	64,977	(1,034)	63,943	82,471	(18,528)
2068	65,540	(1,075)	64,465	83,721	(19,256)
2069	66,103	(1,116)	64,987	84,972	(19,985)
2070	66,670	(1,158)	65,512	86,222	(20,710)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	(3,088)	1,416	12,119	8,340		300.5	2.8		89.7		1,530	2,737	23,447
2016	26	3,045	22,501	8,490		178.5	2.1		82.0		1,531	2,637	38,492
2017	27	3,106	22,889	8,641		120.5	1.4		73.3		1,531	1,876	38,265
2018	28	3,168	23,277	8,791		2.9	0.7		64.6		1,530	736	37,597
2019	29	3,229	23,664	8,941		1.7			55.9		1,530	587	38,038
2020	30	3,291	24,052	9,092		0.3			53.2		1,557	493	38,568
2021	22	3,352	24,469	9,242					45.2		1,595	429	39,154
2022	15	3,413	24,885	9,393					35.4		1,513	369	39,623
2023	7	3,475	25,301	9,546					24.3		1,468	305	40,126
2024	(0)	3,536	25,718	9,697					11.8		1,443	208	40,613
2025	(8)	3,597	26,134	9,847					1.0		1,426	133	41,131
2026	(15)	3,659	26,550	9,997							1,426	79	41,696
2027	(23)	3,720	26,967	10,148							1,426	24	42,262
2028	(30)	3,782	27,383	10,298							1,426	24	42,884
2029	(38)	3,843	27,800	10,449							1,426	25	43,505
2030	(45)	3,904	28,216	10,599							1,426	25	44,126
2031	(60)	3,970	28,655	10,762							1,426	26	44,779
2032	(75)	4,036	29,095	10,924							1,426	26	45,433
2033	(90)	4,102	29,534	11,087							1,426	26	46,086
2034	(105)	4,168	29,974	11,246							1,426	27	46,737
2035	(119)	4,234	30,413	11,409							1,426	27	47,390
2036	(134)	4,300	30,853	11,572							1,426	28	48,044
2037	(149)	4,366	31,292	11,734							1,426	28	48,698
2038	(164)	4,432	31,731	11,894							1,426	29	49,348
2039	(179)	4,498	32,171	12,056							1,426	29	50,002
2040	(193)	4,564	32,610	12,219							1,426	29	50,655
2041	(218)	4,624	32,959	12,345							1,426	30	51,166
2042	(242)	4,683	33,307	12,467							1,426	30	51,673
2043	(266)	4,743	33,656	12,593							1,426	30	52,183
2044	(290)	4,803	34,005	12,719							1,426	31	52,693
2045	(314)	4,863	34,353	12,845							1,426	31	53,204
2046	(338)	4,922	34,702	12,967							1,426	31	53,711
2047	(362)	4,982	35,051	13,093							1,426	32	54,221
2048	(386)	5,042	35,399	13,219							1,426	32	54,732
2049	(410)	5,101	35,748	13,345							1,426	32	55,242
2050	(434)	5,161	36,096	13,467							1,426	33	55,749
2051	(465)	5,220	36,409	13,581							1,426	33	56,204
2052	(496)	5,278	36,722	13,694							1,426	33	56,658
2053	(527)	5,337	37,035	13,805							1,426	33	57,110
2054	(559)	5,396	37,348	13,919							1,426	34	57,564
2055	(590)	5,454	37,661	14,029							1,426	34	58,015
2056	(621)	5,513	37,974	14,143							1,426	34	58,470
2057	(652)	5,571	38,287	14,253							1,426	35	58,921
2058	(683)	5,630	38,600	14,367							1,426	35	59,376
2059	(714)	5,689	38,913	14,477							1,426	35	59,827
2060	(745)	5,747	39,226	14,591							1,426	35	60,282
2061	(786)	5,816	39,589	14,723							1,426	36	60,804
2062	(827)	5,885	39,951	14,855							1,426	36	61,326
2063	(869)	5,954	40,313	14,987							1,426	36	61,848
2064	(910)	6,022	40,675	15,119							1,426	37	62,370
2065	(951)	6,091	41,037	15,254							1,426	37	62,895
2066	(992)	6,160	41,399	15,386							1,426	37	63,417
2067	(1,034)	6,229	41,761	15,518							1,426	38	63,939
2068	(1,075)	6,297	42,124	15,650							1,426	38	64,461
2069	(1,116)	6,366	42,486	15,782							1,426	38	64,983
2070	(1,158)	6,435	42,848	15,917							1,426	39	65,508

9 Region K Challenges

Listed below are challenges the LCRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

It became apparent through field interviews with utility staff that not all utilities were aware of impending shortages in the region, or of their portion of the WMS supply volume for municipal conservation. There is a heightened awareness in the Central Texas area, probably due to the influence of the City of Austin. However, the awareness wanes further toward the coast.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the LCRWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The LCRWPG should educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The LCRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Region K are considering Advanced Metering Infrastructure (AMI). AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and LCRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the LCRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region K, the most common suggested activities were to install AMI with a customer engagement portal component to help reduce water loss and inform customers about their water use patterns. Other suggestions included continuing to use periodic, strategic water rate increases to reduce consumption. Rain barrels are more effective in Region K than in many other regions of the state and are used successfully by some in this region. Twice-per-week watering ordinances could save many utilities large amounts of water in this region, as well.

10.5 Assistance from Wholesale Water Providers

Wholesale Water Provider (WWPs) are uniquely positioned to encourage conservation and achieve actionable results. These entities set water purchase rates and form water delivery contracts—two instances that provide opportunities to introduce conservation incentives. They have a direct interest in conserving as their water systems are expected to shoulder the burden of rapidly increasing populations and water demand. WWPs can also easily carry out district or system-wide conservation initiatives that can be easily adopted by cities with lesser resources.

The TWDB's Water Conservation Advisory Council recently adopted BMP that outlines this purpose and forward-thinking WWPs, such as Lower Colorado River Authority (LCRA), are already advancing this concept.

Here are several ways mentioned that WWPs can assist their customers with conservation:

- WWP conduct yearly water conservation plan implementation surveys to monitor progress of individual customer plan implementation and to quantify water savings from implementation of customer programs where possible.
- Develop a tracking system to track technical assistance and outreach activities
- Development of model water conservation plans and drought contingency plans that could be adopted by WWP customers
- Assistance to customers developing their own water conservation plans and drought contingency plans.
- Researching and providing advice on how to implement specific conservation programs or measures (Texas Water Development Board, 2013a)

In Region K, LCRA in particular has been instrumental in providing wholesale customers access to a variety of rebate and education programs, as well as dedicating WWP staff to monitoring and facilitating conservation throughout the authority's footprint.

10.6 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project Report to the South Central Texas Regional Water Planning Group Region L • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region L make up approximately 2,100,000 in population by 2020, which is 71 percent of the region's total projected 2020 population.
- Participating utilities make up 77 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of 11 participating water utilities in place—and without further enhancement—Region L as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 2,672 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2070 supply volume by 82,327 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of 11 participating water utilities in place—and without further enhancement—these 11 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 2,759 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2027 supply volume by 149 acre-feet per year.
- Of those utilities surveyed, the region averages 5 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

The South Central Texas Region includes all or part of 21 counties. It ranges from arid south Texas to the Gulf of Mexico. It is a rapidly growing region with a wide range of economies and life styles.

The Region L Plan states, "[t]he South Central Texas Regional Water Planning Group (SCTRWPG) strongly supports water conservation, and for the 2016 Regional Water Plan has recommended [multiple] municipal water conservation water management strategies." The plan calls for 97,947 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016j). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region L are 23,426 acre-feet per year for 2020, 26,804 acre-feet per year for 2030, 32,188 acre-feet per year for 2040, 49,505 acre-feet per year for 2050, and 74,125 acre-feet per year for 2060.

municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region L, 17 utilities met these criteria and were contacted for participation. Out of the 17, 11 utilities accepted and were included in the results:

Alamo Heights	San Antonio Water System
Atascosa Rural WSC	San Marcus
Crystal Clear WSC	Universal City
Hondo	Uvalde
New Braunfels	Victoria
Sabinal	

These utilities represent 71 percent of the 2020 population of Region L and represent 71 percent of the 2020 WMS supply volume for municipal water conservation for the region.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for municipal conservation, Region L used a target of 140 GPCD,[3] as recommended by the Water Conservation Implementation Task Force. The objective of recommended BMPs is to reduce demand by one percent per year for WUGs over 140 GPCD, and by .25 percent per year for WUGs under 140 GPCD (Texas Water Development Board, 2016j).

4.2 Approach to Meeting Recommended Supply Volumes

SCTRWPG recommends the following conservation strategies (activities) for Region L:

- Low-flow plumbing fixtures
- Water efficient appliances
- Landscape Restrictions
- Repair plumbing and water-using appliances for leaks
- Modification of personal behavior that controls the use of plumbing fixtures appliances, and lawn watering methods

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region L. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region L.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
L	11	7	0	0	2	1	0	2	0	5	27	55	5.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region L is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized was to use the most complete water loss data possible, which was represented by the

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections

for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may

create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 South Central Texas Regional Water Plan recommends that Region L should achieve 97,947 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the 11 utilities surveyed in this region are estimated to exceed their portion of the regional WMS supply volume for municipal conservation through the year 2027. Without further action, these utilities are estimated to have a deficit of 51,526 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 30,801 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region’s participating utilities’ quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 11 participating utilities. These utilities constitute approximately 71 percent of the region’s population and account for 77 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings For Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (As Of 2015) For Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings From All Conservation Activity For Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume For Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume For Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume For Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared To Participants' Conservation WMS Supply Volumes (In Acre-Feet Per Year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	12,952	4,953	17,905	7,998	0	7,998	9,907
2016	15,031	4,999	20,031	9,997	0	9,997	10,034
2017	15,570	5,046	20,616	9,997	0	9,997	10,619
2018	15,536	5,092	20,628	11,997	0	11,997	8,631
2019	15,497	5,139	20,636	13,996	0	13,996	6,640
2020	15,568	5,185	20,754	17,995	0	17,995	2,759
2021	15,439	5,246	20,685	17,892	0	17,892	2,794
2022	15,487	5,307	20,794	17,788	0	17,788	3,006
2023	15,581	5,368	20,948	17,685	0	17,685	3,263
2024	15,690	5,429	21,119	17,582	0	17,582	3,537
2025	15,793	5,489	21,283	17,479	0	17,479	3,804
2026	13,485	5,550	19,036	17,375	0	17,375	1,660
2027	11,810	5,611	17,421	17,272	0	17,272	149
2028	10,550	5,672	16,222	17,169	0	17,169	(946)
2029	9,291	5,733	15,024	17,065	0	17,065	(2,041)
2030	8,032	5,793	13,825	16,962	0	16,962	(3,137)
2031	7,995	5,847	13,842	17,042	0	17,042	(3,200)
2032	7,958	5,901	13,859	17,122	0	17,122	(3,262)
2033	7,921	5,955	13,876	17,202	0	17,202	(3,326)
2034	7,884	6,009	13,893	17,282	0	17,282	(3,388)
2035	7,809	6,063	13,872	17,362	0	17,362	(3,489)
2036	7,307	6,117	13,424	17,441	0	17,441	(4,017)
2037	7,264	6,171	13,435	17,521	0	17,521	(4,086)
2038	7,249	6,225	13,474	17,601	0	17,601	(4,127)
2039	7,234	6,279	13,513	17,681	0	17,681	(4,168)
2040	7,219	6,333	13,552	17,761	0	17,761	(4,209)
2041	7,205	6,384	13,589	18,960	0	18,960	(5,370)
2042	7,192	6,436	13,628	20,159	0	20,159	(6,531)
2043	7,178	6,488	13,666	21,358	0	21,358	(7,692)
2044	7,164	6,539	13,704	22,557	0	22,557	(8,853)
2045	7,145	6,591	13,736	23,756	0	23,756	(10,019)
2046	7,170	6,643	13,812	24,954	0	24,954	(11,142)
2047	7,194	6,694	13,888	26,153	0	26,153	(12,265)
2048	7,218	6,746	13,964	27,352	0	27,352	(13,388)
2049	7,242	6,798	14,040	28,551	0	28,551	(14,511)
2050	7,267	6,849	14,116	29,750	0	29,750	(15,634)
2051	7,292	6,898	14,191	31,777	0	31,777	(17,586)
2052	7,318	6,947	14,265	33,804	0	33,804	(19,539)
2053	7,344	6,996	14,340	35,831	0	35,831	(21,491)
2054	7,369	7,045	14,415	37,858	0	37,858	(23,443)
2055	7,395	7,094	14,490	39,885	0	39,885	(25,395)
2056	7,421	7,143	14,564	41,912	0	41,912	(27,348)
2057	7,447	7,192	14,639	43,939	0	43,939	(29,300)
2058	7,472	7,241	14,714	45,966	0	45,966	(31,252)
2059	7,498	7,290	14,788	47,993	0	47,993	(33,205)
2060	7,524	7,339	14,863	50,020	0	50,020	(35,157)
2061	7,550	7,389	14,939	51,733	0	51,733	(36,794)
2062	7,576	7,438	15,014	53,445	0	53,445	(38,431)
2063	7,602	7,488	15,090	55,158	0	55,158	(40,068)
2064	7,628	7,538	15,166	56,870	0	56,870	(41,705)
2065	7,654	7,587	15,242	58,583	0	58,583	(43,341)
2066	7,681	7,637	15,317	60,296	0	60,296	(44,978)
2067	7,707	7,686	15,393	62,008	0	62,008	(46,615)
2068	7,733	7,736	15,469	63,721	0	63,721	(48,252)
2069	7,759	7,785	15,544	65,433	0	65,433	(49,889)
2070	7,785	7,835	15,620	67,146	0	67,146	(51,526)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
L	Meeting	6	4,157	5	929	4	4,142	3	245	3	181	1	95
	Not Meeting	5	(1,398)	6	(4,066)	7	(8,351)	8	(15,879)	8	(35,338)	10	(51,621)
	Total Region L	11	2,759	11	(3,137)	11	(4,209)	11	(15,634)	11	(35,157)	11	(51,526)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	12,952	4,953	17,905	10,412	7,493
2016	15,031	4,999	20,031	13,014	7,016
2017	15,570	5,046	20,616	13,014	7,602
2018	15,536	5,092	20,628	15,617	5,011
2019	15,497	5,139	20,636	18,220	2,416
2020	15,568	5,185	20,754	23,426	(2,672)
2021	15,439	5,246	20,685	23,764	(3,079)
2022	15,487	5,307	20,794	24,102	(3,307)
2023	15,581	5,368	20,948	24,439	(3,491)
2024	15,690	5,429	21,119	24,777	(3,658)
2025	15,793	5,489	21,283	25,115	(3,832)
2026	13,485	5,550	19,036	25,453	(6,417)
2027	11,810	5,611	17,421	25,791	(8,370)
2028	10,550	5,672	16,222	26,128	(9,906)
2029	9,291	5,733	15,024	26,466	(11,442)
2030	8,032	5,793	13,825	26,804	(12,979)
2031	7,995	5,847	13,842	27,342	(13,500)
2032	7,958	5,901	13,859	27,881	(14,021)
2033	7,921	5,955	13,876	28,419	(14,543)
2034	7,884	6,009	13,893	28,958	(15,064)
2035	7,809	6,063	13,872	29,496	(15,624)
2036	7,307	6,117	13,424	30,034	(16,610)
2037	7,264	6,171	13,435	30,573	(17,138)
2038	7,249	6,225	13,474	31,111	(17,637)
2039	7,234	6,279	13,513	31,650	(18,137)
2040	7,219	6,333	13,552	32,188	(18,636)
2041	7,205	6,384	13,589	33,920	(20,330)
2042	7,192	6,436	13,628	35,651	(22,024)
2043	7,178	6,488	13,666	37,383	(23,717)
2044	7,164	6,539	13,704	39,115	(25,411)
2045	7,145	6,591	13,736	40,847	(27,110)
2046	7,170	6,643	13,812	42,578	(28,766)
2047	7,194	6,694	13,888	44,310	(30,422)
2048	7,218	6,746	13,964	46,042	(32,077)
2049	7,242	6,798	14,040	47,773	(33,733)
2050	7,267	6,849	14,116	49,505	(35,389)
2051	7,292	6,898	14,191	51,967	(37,776)
2052	7,318	6,947	14,265	54,429	(40,164)
2053	7,344	6,996	14,340	56,891	(42,551)
2054	7,369	7,045	14,415	59,353	(44,938)
2055	7,395	7,094	14,490	61,815	(47,325)
2056	7,421	7,143	14,564	64,277	(49,713)
2057	7,447	7,192	14,639	66,739	(52,100)
2058	7,472	7,241	14,714	69,201	(54,487)
2059	7,498	7,290	14,788	71,663	(56,875)
2060	7,524	7,339	14,863	74,125	(59,262)
2061	7,550	7,389	14,939	76,507	(61,568)
2062	7,576	7,438	15,014	78,889	(63,875)
2063	7,602	7,488	15,090	81,272	(66,181)
2064	7,628	7,538	15,166	83,654	(68,488)
2065	7,654	7,587	15,242	86,036	(70,794)
2066	7,681	7,637	15,317	88,418	(73,101)
2067	7,707	7,686	15,393	90,800	(75,407)
2068	7,733	7,736	15,469	93,183	(77,714)
2069	7,759	7,785	15,544	95,565	(80,021)
2070	7,785	7,835	15,620	97,947	(82,327)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	4,953	805				11					1,424	10,699	17,905
2016	4,999	1,630				13					1,436	11,939	20,031
2017	5,046	2,119				8					1,436	11,993	20,616
2018	5,092	2,142				5					1,436	11,938	20,628
2019	5,139	2,165				3					1,436	11,882	20,636
2020	5,185	2,188				1					1,436	11,936	20,754
2021	5,246	2,211									1,436	11,786	20,685
2022	5,307	2,233									1,436	11,811	20,794
2023	5,368	2,256									1,436	11,883	20,948
2024	5,429	2,279									1,436	11,971	21,119
2025	5,489	2,302									1,436	12,053	21,283
2026	5,550	2,325									1,436	9,723	19,036
2027	5,611	2,348									1,436	8,025	17,421
2028	5,672	2,370									1,436	6,743	16,222
2029	5,733	2,393									1,436	5,461	15,024
2030	5,793	2,416									1,436	4,179	13,825
2031	5,847	2,439									1,436	4,119	13,842
2032	5,901	2,461									1,436	4,059	13,859
2033	5,955	2,484									1,436	3,999	13,876
2034	6,009	2,507									1,436	3,940	13,893
2035	6,063	2,529									1,436	3,842	13,872
2036	6,117	2,552									1,436	3,317	13,424
2037	6,171	2,575									1,436	3,252	13,435
2038	6,225	2,597									1,436	3,214	13,474
2039	6,279	2,620									1,436	3,176	13,513
2040	6,333	2,643									1,436	3,139	13,552
2041	6,384	2,667									1,436	3,101	13,589
2042	6,436	2,691									1,436	3,063	13,628
2043	6,488	2,716									1,436	3,025	13,666
2044	6,539	2,740									1,436	2,987	13,704
2045	6,591	2,764									1,436	2,944	13,736
2046	6,643	2,788									1,436	2,944	13,812
2047	6,694	2,813									1,436	2,944	13,888
2048	6,746	2,837									1,436	2,944	13,964
2049	6,798	2,861									1,436	2,944	14,040
2050	6,849	2,885									1,436	2,944	14,116
2051	6,898	2,911									1,436	2,944	14,191
2052	6,947	2,937									1,436	2,944	14,265
2053	6,996	2,963									1,436	2,944	14,340
2054	7,045	2,988									1,436	2,944	14,415
2055	7,094	3,014									1,436	2,944	14,490
2056	7,143	3,040									1,436	2,944	14,564
2057	7,192	3,066									1,436	2,944	14,639
2058	7,241	3,091									1,436	2,944	14,714
2059	7,290	3,117									1,436	2,944	14,788
2060	7,339	3,143									1,436	2,944	14,863
2061	7,389	3,169									1,436	2,944	14,939
2062	7,438	3,195									1,436	2,944	15,014
2063	7,488	3,221									1,436	2,944	15,090
2064	7,538	3,247									1,436	2,944	15,166
2065	7,587	3,273									1,436	2,944	15,242
2066	7,637	3,299									1,436	2,944	15,317
2067	7,686	3,326									1,436	2,944	15,393
2068	7,736	3,352									1,436	2,944	15,469
2069	7,785	3,378									1,436	2,944	15,544
2070	7,835	3,404									1,436	2,944	15,620

9 Region L Challenges

Listed below are challenges the SCTRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout rural Texas is very low. Traditional municipal conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the SCTRWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The SCTRWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities should be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report as part of this project that provided general recommendations about how to move forward with municipal conservation activities.

The SCTRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar data collection projects in the future. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities around the state are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and SCTRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the SCTRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region L, the most common suggested activities were to install AMI with a customer engagement portal component to help reduce water loss and inform customers about their water use patterns, and the continued use of periodic, strategic water rate increases to reduce consumption. Some parts of the region would benefit from the use of rain barrels and some areas could see high water savings by passing twice-per-week watering ordinances.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Rio Grande Regional Water Planning Group
Region M • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region M make up approximately 1,200,000 in population by 2020, which is 59 percent of the region's total projected 2020 population.
- Participating utilities make up 62 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of 15 participating water utilities in place—and without further enhancement—Region M as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 465 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2070 supply volume by 109,552 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of 15 participating water utilities in place—and without further enhancement—these 15 utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 2,073 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2022 supply volume by 75,107 acre-feet per year.
- Of those utilities surveyed, the region averages 1.8 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region M is an eight-county area stretching from the middle of the Rio Grande River to the Gulf of Mexico. There is a shift toward urbanization and diversification of the economy, but agriculture still plays a major role in the region. Region M is rapidly growing part of the state.

The Region M Plan states, "[a]dvanced water conservation is recommended for every municipal water user group (WUG) in Region M." It further states, "[w]ater conservation is typically a non-capital intensive alternative that any water supply entity can and should pursue." The plan calls for 122,557 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016k). This volume *does not include* supply volumes from irrigation district conservation.[3] Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region M are 27,701 acre-feet per year for 2020, 47,769 acre-feet per year for 2030, 70,351 acre-feet per year for 2040, 105,847 acre-feet per year for 2050, and 135,800 acre-feet per year for 2060.

[3] Recommended volumes from irrigation district-related conservation are slated to come from existing surplus. This differs from all other regions in the state, which classify municipal water conservation as a demand reduction measure.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region M, 24 utilities met these criteria and were contacted for participation. In order to gain valuable insight about water conservation in Region M, the City of Laredo was also included. Out of the 24 invitations, 15 utilities accepted and were included in the results:

Aqua SUD	Olmito WSC
East Rio Hondo WSC	Pharr
Edinburg	San Juan
Hidalgo Cty. MUD 1	Sharyland WSC
Laredo	Union WSC
McAllen	Weslaco
Mission	Zapata Cty. Waterworks
North Alamo WSC	

These utilities represent approximately 59 percent of the 2020 population of Region M and 62 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts. This report summarizes the savings from the individual utility reports within Region M.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for municipal conservation, Region M planners used a target of 140 GPCD,[4] as recommended by the Water Conservation Implementation Task Force. The objective of recommended BMPs is to reduce demand by one percent per year for WUGs over 140 GPCD, and by 0.5 percent per year for WUGs under 140 GPCD.

---

[4] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

In addition, "[t]he yield of Advanced Water Conservation, or the amount of water conserved in each decade, is the difference between the Per Capita Water Use and the Base Per Capita Goal, converted to acre-feet/year" (Texas Water Development Board, 2016k).

4.2 Approach to Meeting Recommended Supply Volumes

The Rio Grande Regional Water Planning Group (RGRWPG) recommends the following conservation strategies for Region M:

- System Operations
- Landscaping
- Education and Public Awareness
- Rebate, Retrofit, and Incentive Programs
- Conservation Technology (Includes Rainwater Harvesting)
- Regulatory Enforcement

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region M. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region M.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
M	15	9	0	1	0	1	0	0	0	1	0	27	1.8

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately on a large scale to ensure Region M is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[5] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[6] for that year.[7] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the

[5] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[6] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[7] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

difference between each individual utility's baseline[8] for water loss GPCD[9] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

---

[8] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

6.2.1 *Caveats to specific activity savings*

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Rio Grande Regional Water Plan recommends that Region M should achieve 122,557 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. 50,441 acre-feet per year in 2070 are to be supplied by non-traditional irrigation district-related conservation that is slated to come from existing surplus. This volume is not considered in this report as municipal conservation.

The results of this study indicate that the 15 utilities surveyed in this region are estimated to exceed their portion of the recommended supply volume through the year 2023. If no other actions are taken, they are estimated to accrue a deficit of 75,107 acre-feet per year of their portion of the regional supply volume (88,112 acre-feet per year) by the end of the planning period. Non-participating municipal WUGs have a WMS supply volume for municipal conservation of 34,445 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the 15 participating utilities. These utilities constitute approximately 59 percent of the region's population and account for 62 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	2,139	2,983	5,121	1,869	0	1,869	3,252
2016	2,685	3,058	5,743	2,337	0	2,337	3,406
2017	2,743	3,133	5,876	2,337	0	2,337	3,539
2018	2,804	3,208	6,012	2,804	0	2,804	3,208
2019	2,859	3,283	6,142	3,271	0	3,271	2,871
2020	2,921	3,358	6,279	4,206	0	4,206	2,073
2021	2,979	3,432	6,411	5,102	0	5,102	1,310
2022	3,041	3,507	6,547	5,997	0	5,997	550
2023	3,099	3,581	6,680	6,893	0	6,893	(213)
2024	3,157	3,655	6,813	7,788	0	7,788	(976)
2025	3,219	3,730	6,948	8,684	0	8,684	(1,736)
2026	3,277	3,804	7,081	9,580	0	9,580	(2,498)
2027	3,338	3,879	7,217	10,475	0	10,475	(3,258)
2028	3,397	3,953	7,350	11,371	0	11,371	(4,021)
2029	3,458	4,027	7,486	12,266	0	12,266	(4,781)
2030	3,517	4,102	7,618	13,162	0	13,162	(5,544)
2031	3,579	4,176	7,755	14,426	0	14,426	(6,672)
2032	3,638	4,250	7,888	15,691	0	15,691	(7,803)
2033	3,700	4,324	8,024	16,955	0	16,955	(8,931)
2034	3,762	4,398	8,160	18,219	0	18,219	(10,059)
2035	3,822	4,472	8,294	19,484	0	19,484	(11,190)
2036	3,884	4,546	8,430	20,748	0	20,748	(12,318)
2037	3,946	4,620	8,566	22,012	0	22,012	(13,446)
2038	4,005	4,694	8,699	23,276	0	23,276	(14,577)
2039	4,068	4,768	8,836	24,541	0	24,541	(15,705)
2040	4,127	4,842	8,969	25,805	0	25,805	(16,836)
2041	4,190	4,914	9,104	27,648	0	27,648	(18,544)
2042	4,253	4,985	9,238	29,490	0	29,490	(20,252)
2043	4,316	5,057	9,373	31,333	0	31,333	(21,960)
2044	4,376	5,128	9,504	33,175	0	33,175	(23,671)
2045	4,439	5,200	9,639	35,018	0	35,018	(25,379)
2046	4,502	5,271	9,774	36,861	0	36,861	(27,087)
2047	4,565	5,343	9,908	38,703	0	38,703	(28,795)
2048	4,625	5,415	10,040	40,546	0	40,546	(30,506)
2049	4,689	5,486	10,175	42,388	0	42,388	(32,214)
2050	4,752	5,558	10,309	44,231	0	44,231	(33,922)
2051	4,816	5,632	10,448	46,366	0	46,366	(35,918)
2052	4,879	5,707	10,586	48,500	0	48,500	(37,914)
2053	4,943	5,782	10,725	50,635	0	50,635	(39,909)
2054	5,007	5,856	10,864	52,769	0	52,769	(41,905)
2055	5,071	5,931	11,002	54,904	0	54,904	(43,901)
2056	5,132	6,006	11,138	57,038	0	57,038	(45,900)
2057	5,196	6,081	11,276	59,173	0	59,173	(47,896)
2058	5,260	6,155	11,415	61,307	0	61,307	(49,892)
2059	5,324	6,230	11,553	63,442	0	63,442	(51,888)
2060	5,387	6,305	11,692	65,576	0	65,576	(53,884)
2061	5,450	6,374	11,824	67,830	0	67,830	(56,006)
2062	5,513	6,443	11,956	70,083	0	70,083	(58,127)
2063	5,572	6,512	12,085	72,337	0	72,337	(60,252)
2064	5,635	6,582	12,217	74,590	0	74,590	(62,374)
2065	5,698	6,651	12,349	76,844	0	76,844	(64,495)
2066	5,760	6,720	12,481	79,098	0	79,098	(66,617)
2067	5,820	6,789	12,609	81,351	0	81,351	(68,742)
2068	5,883	6,859	12,741	83,605	0	83,605	(70,863)
2069	5,945	6,928	12,873	85,858	0	85,858	(72,985)
2070	6,008	6,997	13,005	88,112	0	88,112	(75,107)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
M	Meeting	11	4,751	7	4,071	4	3,308	1	206	0	0	0	0
	Not Meeting	4	(2,678)	8	(9,615)	11	(20,144)	14	(34,128)	15	(53,884)	15	(75,107)
	Total Region M	15	2,073	15	(5,544)	15	(16,836)	15	(33,922)	15	(53,884)	15	(75,107)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Total Regional WMS Volume – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

Unaccounted for Conservation WMS Volume – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	2,139	2,983	5,121	2,997	2,124
2016	2,685	3,058	5,743	3,747	1,996
2017	2,743	3,133	5,876	3,747	2,129
2018	2,804	3,208	6,012	4,496	1,516
2019	2,859	3,283	6,142	5,245	897
2020	2,921	3,358	6,279	6,744	(465)
2021	2,979	3,432	6,411	8,158	(1,747)
2022	3,041	3,507	6,547	9,573	(3,026)
2023	3,099	3,581	6,680	10,987	(4,307)
2024	3,157	3,655	6,813	12,402	(5,589)
2025	3,219	3,730	6,948	13,816	(6,868)
2026	3,277	3,804	7,081	15,230	(8,149)
2027	3,338	3,879	7,217	16,645	(9,428)
2028	3,397	3,953	7,350	18,059	(10,709)
2029	3,458	4,027	7,486	19,474	(11,988)
2030	3,517	4,102	7,618	20,888	(13,270)
2031	3,579	4,176	7,755	22,545	(14,790)
2032	3,638	4,250	7,888	24,202	(16,314)
2033	3,700	4,324	8,024	25,859	(17,835)
2034	3,762	4,398	8,160	27,516	(19,355)
2035	3,822	4,472	8,294	29,173	(20,879)
2036	3,884	4,546	8,430	30,829	(22,400)
2037	3,946	4,620	8,566	32,486	(23,920)
2038	4,005	4,694	8,699	34,143	(25,444)
2039	4,068	4,768	8,836	35,800	(26,964)
2040	4,127	4,842	8,969	37,457	(28,488)
2041	4,190	4,914	9,104	39,891	(30,787)
2042	4,253	4,985	9,238	42,324	(33,086)
2043	4,316	5,057	9,373	44,758	(35,385)
2044	4,376	5,128	9,504	47,191	(37,687)
2045	4,439	5,200	9,639	49,625	(39,985)
2046	4,502	5,271	9,774	52,058	(42,284)
2047	4,565	5,343	9,908	54,492	(44,583)
2048	4,625	5,415	10,040	56,925	(46,885)
2049	4,689	5,486	10,175	59,359	(49,184)
2050	4,752	5,558	10,309	61,792	(51,483)
2051	4,816	5,632	10,448	64,699	(54,251)
2052	4,879	5,707	10,586	67,605	(57,019)
2053	4,943	5,782	10,725	70,512	(59,786)
2054	5,007	5,856	10,864	73,418	(62,554)
2055	5,071	5,931	11,002	76,325	(65,322)
2056	5,132	6,006	11,138	79,231	(68,093)
2057	5,196	6,081	11,276	82,138	(70,861)
2058	5,260	6,155	11,415	85,044	(73,629)
2059	5,324	6,230	11,553	87,951	(76,397)
2060	5,387	6,305	11,692	90,857	(79,165)
2061	5,450	6,374	11,824	94,027	(82,203)
2062	5,513	6,443	11,956	97,197	(85,241)
2063	5,572	6,512	12,085	100,367	(88,282)
2064	5,635	6,582	12,217	103,537	(91,320)
2065	5,698	6,651	12,349	106,707	(94,358)
2066	5,760	6,720	12,481	109,877	(97,396)
2067	5,820	6,789	12,609	113,047	(100,438)
2068	5,883	6,859	12,741	116,217	(103,476)
2069	5,945	6,928	12,873	119,387	(106,514)
2070	6,008	6,997	13,005	122,557	(109,552)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[12] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	2,983	2,048		55							36		5,122
2016	3,058	2,591		56							36		5,742
2017	3,133	2,650		58							36		5,876
2018	3,208	2,708		59							36		6,011
2019	3,283	2,767		60							33		6,143
2020	3,358	2,825		62							33		6,277
2021	3,432	2,884		63							33		6,412
2022	3,507	2,942		64							33		6,546
2023	3,581	3,001		65							33		6,680
2024	3,655	3,059		67							33		6,814
2025	3,730	3,118		68							33		6,948
2026	3,804	3,176		69							33		7,082
2027	3,879	3,234		71							33		7,217
2028	3,953	3,293		72							33		7,351
2029	4,027	3,351		73							33		7,485
2030	4,102	3,410		74							33		7,619
2031	4,176	3,470		76							33		7,754
2032	4,250	3,529		77							33		7,889
2033	4,324	3,589		78							33		8,024
2034	4,398	3,649		80							33		8,159
2035	4,472	3,709		81							33		8,295
2036	4,546	3,768		82							33		8,430
2037	4,620	3,828		84							33		8,565
2038	4,694	3,888		85							33		8,700
2039	4,768	3,947		86							33		8,835
2040	4,842	4,007		88							33		8,970
2041	4,914	4,068		89							33		9,104
2042	4,985	4,129		91							33		9,238
2043	5,057	4,190		92							33		9,372
2044	5,128	4,251		93							33		9,506
2045	5,200	4,312		95							33		9,640
2046	5,271	4,373		96							33		9,773
2047	5,343	4,434		97							33		9,907
2048	5,415	4,495		99							33		10,041
2049	5,486	4,556		100							33		10,175
2050	5,558	4,617		102							33		10,309
2051	5,632	4,679		103							33		10,447
2052	5,707	4,741		104							33		10,586
2053	5,782	4,804		106							33		10,724
2054	5,856	4,866		107							33		10,862
2055	5,931	4,928		109							33		11,001
2056	6,006	4,990		110							33		11,139
2057	6,081	5,052		111							33		11,277
2058	6,155	5,115		113							33		11,416
2059	6,230	5,177		114							33		11,554
2060	6,305	5,239		116							33		11,692
2061	6,374	5,300		117							33		11,823
2062	6,443	5,360		118							33		11,955
2063	6,512	5,421		120							33		12,086
2064	6,582	5,482		121							33		12,217
2065	6,651	5,542		123							33		12,348
2066	6,720	5,603		124							33		12,480
2067	6,789	5,663		125							33		12,611
2068	6,859	5,724		127							33		12,742
2069	6,928	5,785		128							33		12,873
2070	6,997	5,845		129							33		13,005

9 Region M Challenges

Listed below are challenges the RGRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in rural Texas is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the RGRWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The RGRWPG could educate all the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities could be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The RGRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar data collection projects in the future. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Region M are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and RGRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the RGRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE

offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region M, the most common suggested activities were to install AMI with a customer engagement portal component to help reduce water loss and inform customers about their water use patterns, and to continue to use periodic, strategic water rate increases to reduce consumption. Twice-per-week watering ordinances were also suggested, and rain barrels could also be useful in some areas of the region.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Coastal Bend Regional Water Planning Area
Region N • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

Task 1: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 2: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 3: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.

Task 4: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.

Task 5: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.

Task 6: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region N make up approximately 370,000 in population by 2020, which is 60 percent of the region's total projected 2020 population.
- Participating utilities make up 72 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of two participating water utilities in place—and without further enhancement—Region N as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 1,022 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2022 supply volume by 253 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of two participating water utilities in place—and without further enhancement—these two utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 1,959 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2023 supply volume by 472 acre-feet per year, but will fall short of their 2024 volume by 24 acre-feet per year.
- Of those utilities surveyed, the region averages two activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region N is an 11-county area near the Gulf of Mexico. The major water demand areas are primarily municipal systems in the greater Corpus Christi area.

The Region N Plan states, "[t]he purpose of the municipal water conservation water management strategy is to evaluate the potential for additional municipal water conservation for inclusion in the Regional Water Plan to meet a part of the projected water needs (shortages) of each municipal entity." The plan calls for 17,041 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016l). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.
[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region N are 3,367 acre-feet per year for 2020, 10,046 acre-feet per year for 2030, 15,000 acre-feet per year for 2040, 15,702 acre-feet per year for 2050, and 16,485 acre-feet per year for 2060.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region N, one utility met these criteria and was contacted for participation. In order to gain valuable insight about water conservation in Region N, the City of Corpus Christi was also contact and agreed to participate. Overall, two utilities accepted and were included in the results:

Nueces County WCID #3	Corpus Christi

These utilities represent approximately 60 percent of the 2020 population of Region N and 72 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts as part of the project. This report summarizes the savings from the individual utility reports within Region N.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a

common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for municipal conservation, Region N planners used a target of 140 GPCD,[3] as recommended by the Water Conservation Implementation Task Force. The objective of recommended BMPs is to reduce demand by one percent per year for WUGs over 140 GPCD (Texas Water Development Board, 2016l).

4.2 Approach to Meeting Recommended Supply Volumes

The Coastal Bend Regional Water Planning Group (CBRWPG) made the following recommendations for municipal conservation:

- Water conservation pricing
- Prohibition on wasting water

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- School education
- Landscape irrigation conservation
- Metering connections and retrofits
- Plumbing and retrofits and replacements
- Other BMPs identified by WUGs

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region N. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region N.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
N	2	1	0	0	0	0	0	1	0	0	0	4	2.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately to ensure Region N is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).
[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility’s service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Coastal Bend Regional Water Plan recommends that Region N should achieve 17,041 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the two utilities surveyed in this region are estimated to meet their portion of WMS supply volume through the year 2023. Beyond that, if no other actions are taken, the region is estimated to accrue a deficit of 6,556 acre-feet per year by 2070. Non-participating municipal WUGs have a WMS supply volume for municipal conservation of 5,259 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the two participating utilities. These utilities constitute approximately 60 percent of the region's population and account for 72 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	859	778	1,637	1,080	0	1,080	557
2016	3,419	799	4,218	1,350	0	1,350	2,868
2017	3,441	820	4,261	1,350	0	1,350	2,911
2018	3,463	840	4,304	1,620	0	1,620	2,684
2019	3,486	861	4,346	1,890	0	1,890	2,456
2020	3,508	881	4,389	2,430	0	2,430	1,959
2021	3,530	889	4,419	2,956	0	2,956	1,463
2022	3,552	897	4,450	3,482	0	3,482	968
2023	3,575	905	4,480	4,008	0	4,008	472
2024	3,597	913	4,510	4,534	0	4,534	(24)
2025	3,619	921	4,540	5,060	0	5,060	(520)
2026	3,641	928	4,570	5,586	0	5,586	(1,016)
2027	3,664	936	4,600	6,112	0	6,112	(1,512)
2028	3,686	944	4,630	6,638	0	6,638	(2,008)
2029	3,708	952	4,660	7,164	0	7,164	(2,504)
2030	3,731	960	4,690	7,690	0	7,690	(3,000)
2031	3,743	965	4,708	8,073	0	8,073	(3,365)
2032	3,756	970	4,725	8,455	0	8,455	(3,730)
2033	3,769	974	4,743	8,838	0	8,838	(4,095)
2034	3,781	979	4,760	9,221	0	9,221	(4,460)
2035	3,794	984	4,778	9,604	0	9,604	(4,826)
2036	3,806	989	4,795	9,986	0	9,986	(5,191)
2037	3,819	994	4,813	10,369	0	10,369	(5,556)
2038	3,832	999	4,830	10,752	0	10,752	(5,921)
2039	3,844	1,004	4,848	11,134	0	11,134	(6,286)
2040	3,857	1,008	4,866	11,517	0	11,517	(6,651)
2041	3,865	1,016	4,881	11,507	0	11,507	(6,626)
2042	3,872	1,025	4,897	11,497	0	11,497	(6,600)
2043	3,880	1,033	4,913	11,486	0	11,486	(6,574)
2044	3,888	1,041	4,928	11,476	0	11,476	(6,548)
2045	3,895	1,049	4,944	11,466	0	11,466	(6,522)
2046	3,903	1,057	4,960	11,456	0	11,456	(6,496)
2047	3,911	1,065	4,976	11,446	0	11,446	(6,470)
2048	3,918	1,073	4,991	11,435	0	11,435	(6,444)
2049	3,926	1,081	5,007	11,425	0	11,425	(6,418)
2050	3,933	1,089	5,023	11,415	0	11,415	(6,392)
2051	3,941	1,094	5,035	11,438	0	11,438	(6,403)
2052	3,948	1,099	5,047	11,462	0	11,462	(6,414)
2053	3,956	1,104	5,060	11,485	0	11,485	(6,425)
2054	3,963	1,109	5,072	11,509	0	11,509	(6,436)
2055	3,971	1,114	5,084	11,532	0	11,532	(6,448)
2056	3,978	1,118	5,097	11,555	0	11,555	(6,459)
2057	3,986	1,123	5,109	11,579	0	11,579	(6,470)
2058	3,993	1,128	5,121	11,602	0	11,602	(6,481)
2059	4,001	1,133	5,134	11,626	0	11,626	(6,492)
2060	4,008	1,138	5,146	11,649	0	11,649	(6,503)
2061	4,014	1,140	5,154	11,662	0	11,662	(6,508)
2062	4,019	1,143	5,162	11,676	0	11,676	(6,514)
2063	4,024	1,146	5,170	11,689	0	11,689	(6,519)
2064	4,030	1,148	5,178	11,702	0	11,702	(6,524)
2065	4,035	1,151	5,186	11,716	0	11,716	(6,530)
2066	4,041	1,153	5,194	11,729	0	11,729	(6,535)
2067	4,046	1,156	5,202	11,742	0	11,742	(6,540)
2068	4,051	1,158	5,210	11,755	0	11,755	(6,546)
2069	4,057	1,161	5,218	11,769	0	11,769	(6,551)
2070	4,062	1,164	5,226	11,782	0	11,782	(6,556)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
N	Meeting	1	1,998		0		0		0		0		0
	Not Meeting	1	(40)	2	(3,000)	2	(6,651)	2	(6,401)	2	(6,501)	2	(6,566)
	Total Region N	2	1,959	2	(3,000)	2	(6,651)	2	(6,392)	2	(6,503)	2	(6,566)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Total Regional WMS Volume</u> – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

<u>Unaccounted for Conservation WMS Volume</u> – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	859	778	1,637	1,496	140
2016	3,419	799	4,218	1,871	2,347
2017	3,441	820	4,261	1,871	2,390
2018	3,463	840	4,304	2,245	2,059
2019	3,486	861	4,346	2,619	1,728
2020	3,508	881	4,389	3,367	1,022
2021	3,530	889	4,419	4,035	385
2022	3,552	897	4,450	4,703	(253)
2023	3,575	905	4,480	5,371	(891)
2024	3,597	913	4,510	6,039	(1,529)
2025	3,619	921	4,540	6,707	(2,167)
2026	3,641	928	4,570	7,374	(2,804)
2027	3,664	936	4,600	8,042	(3,442)
2028	3,686	944	4,630	8,710	(4,080)
2029	3,708	952	4,660	9,378	(4,718)
2030	3,731	960	4,690	10,046	(5,356)
2031	3,743	965	4,708	10,541	(5,834)
2032	3,756	970	4,725	11,037	(6,311)
2033	3,769	974	4,743	11,532	(6,789)
2034	3,781	979	4,760	12,028	(7,267)
2035	3,794	984	4,778	12,523	(7,745)
2036	3,806	989	4,795	13,018	(8,223)
2037	3,819	994	4,813	13,514	(8,701)
2038	3,832	999	4,830	14,009	(9,179)
2039	3,844	1,004	4,848	14,505	(9,657)
2040	3,857	1,008	4,866	15,000	(10,134)
2041	3,865	1,016	4,881	15,070	(10,189)
2042	3,872	1,025	4,897	15,140	(10,243)
2043	3,880	1,033	4,913	15,211	(10,298)
2044	3,888	1,041	4,928	15,281	(10,352)
2045	3,895	1,049	4,944	15,351	(10,407)
2046	3,903	1,057	4,960	15,421	(10,461)
2047	3,911	1,065	4,976	15,491	(10,516)
2048	3,918	1,073	4,991	15,562	(10,570)
2049	3,926	1,081	5,007	15,632	(10,625)
2050	3,933	1,089	5,023	15,702	(10,679)
2051	3,941	1,094	5,035	15,780	(10,745)
2052	3,948	1,099	5,047	15,859	(10,811)
2053	3,956	1,104	5,060	15,937	(10,877)
2054	3,963	1,109	5,072	16,015	(10,943)
2055	3,971	1,114	5,084	16,094	(11,009)
2056	3,978	1,118	5,097	16,172	(11,075)
2057	3,986	1,123	5,109	16,250	(11,141)
2058	3,993	1,128	5,121	16,328	(11,207)
2059	4,001	1,133	5,134	16,407	(11,273)
2060	4,008	1,138	5,146	16,485	(11,339)
2061	4,014	1,140	5,154	16,541	(11,386)
2062	4,019	1,143	5,162	16,596	(11,434)
2063	4,024	1,146	5,170	16,652	(11,482)
2064	4,030	1,148	5,178	16,707	(11,529)
2065	4,035	1,151	5,186	16,763	(11,577)
2066	4,041	1,153	5,194	16,819	(11,625)
2067	4,046	1,156	5,202	16,874	(11,672)
2068	4,051	1,158	5,210	16,930	(11,720)
2069	4,057	1,161	5,218	16,985	(11,768)
2070	4,062	1,164	5,226	17,041	(11,815)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	778	859											1,637
2016	799	3,419											4,218
2017	820	3,441											4,261
2018	840	3,463											4,304
2019	861	3,486											4,346
2020	881	3,508											4,389
2021	889	3,530											4,419
2022	897	3,552											4,450
2023	905	3,575											4,480
2024	913	3,597											4,510
2025	921	3,619											4,540
2026	928	3,641											4,570
2027	936	3,664											4,600
2028	944	3,686											4,630
2029	952	3,708											4,660
2030	960	3,731											4,690
2031	965	3,743											4,708
2032	970	3,756											4,725
2033	974	3,769											4,743
2034	979	3,781											4,760
2035	984	3,794											4,778
2036	989	3,806											4,795
2037	994	3,819											4,813
2038	999	3,832											4,830
2039	1,004	3,844											4,848
2040	1,008	3,857											4,866
2041	1,016	3,865											4,881
2042	1,025	3,872											4,897
2043	1,033	3,880											4,913
2044	1,041	3,888											4,928
2045	1,049	3,895											4,944
2046	1,057	3,903											4,960
2047	1,065	3,911											4,976
2048	1,073	3,918											4,991
2049	1,081	3,926											5,007
2050	1,089	3,933											5,023
2051	1,094	3,941											5,035
2052	1,099	3,948											5,047
2053	1,104	3,956											5,060
2054	1,109	3,963											5,072
2055	1,114	3,971											5,084
2056	1,118	3,978											5,097
2057	1,123	3,986											5,109
2058	1,128	3,993											5,121
2059	1,133	4,001											5,134
2060	1,138	4,008											5,146
2061	1,140	4,014											5,154
2062	1,143	4,019											5,162
2063	1,146	4,024											5,170
2064	1,148	4,030											5,178
2065	1,151	4,035											5,186
2066	1,153	4,041											5,194
2067	1,156	4,046											5,202
2068	1,158	4,051											5,210
2069	1,161	4,057											5,218
2070	1,164	4,062											5,226

9 Region N Challenges

Listed below are challenges the CBRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout Texas is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the CBRWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The CBRWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities could be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The CBRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in future similar data collection projects. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in the state are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and CBRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the CBRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region N, the most common suggested activities were to install AMI with a customer portal component to help reduce water loss and inform customers about their water use patterns, and to use periodic, strategic water rate increases to reduce consumption. Rain barrels in this part of the state can be effective, and twice-per-week watering ordinances offer significant savings that have not yet been tapped.

See Section 9 in the State Report that is part of this document for an extended discussion on these suggested activities and why they were chosen.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Llano Estacado Regional Water Planning Group
Region O • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- Participating utilities in Region O make up approximately 300,000 in population by 2020, which is 55 percent of the region's total projected 2020 population.
- Participating utilities make up 62 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of six participating water utilities in place—and without further enhancement—Region O as a whole is projected to exceed its recommended 2020 water conservation supply volume by 1,226 acre-feet per year.
- With the current conservation activities of six participating water utilities in place—and without further enhancement—these six utilities are projected to exceed their collective recommended 2020 water conservation supply volume by 2,816 acre-feet per year.[1]
- Without further activity, these utilities are projected to exceed their collective 2070 supply volume by 4,190 acre-feet per year.
- Of those utilities surveyed, the region averages 2.7 activities performed per utility

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region O is a 21-county region encompassing the Panhandle of Texas. It is a sparsely populated, agricultural region. This region is not considered a rapidly growing area of the state.

The Region O Plan states, "[i]n addition to lowering overall water demand, municipal water conservation can level out the peak demand experienced in the summer. Therefore, conservation can delay the need for new water supply projects and/or reduce the scale of new projects." The plan calls for 5,774 acre-feet of savings to come from municipal water conservation annually by 2070[2] (Texas Water Development Board, 2016m). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region O are 4,204 acre-feet per year for 2020, 4,403 acre-feet per year for 2030, 4,774 acre-feet per year for 2040, 5,071 acre-feet per year for 2050, and 5,419 acre-feet per year for 2060.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region O, nine utilities met these criteria and were contacted for participation. Six utilities accepted and were included in the results:

Brownfield	Lubbock
Lamesa	Seminole
Levelland	Silverton

These utilities represent approximately 55 percent of the 2020 population of Region O and 62 percent of the 2020 WMS supply volume for municipal water conservation for the region.

Each of the participating utilities received a report on the results of its water conservation activities and water loss efforts as part of this project. This report summarizes the savings from the individual utility reports within Region O.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for municipal conservation, Region O planners used a target of 140 GPCD,[3] as recommended by the Water Conservation Implementation Task Force. The plan recommends that WUGs over 140 GPCD reduce demand by 0.5 percent per year until 140 GPCD is reached (Texas Water Development Board, 2016m).

4.2 Approach to Meeting Recommended Supply Volumes

The Llano Estacado Regional Water Planning Group (LERWPG) recommended the following municipal conservation strategies (activities) for the WUGs within Region O:

- Administrative which includes outdoor water audits and public education
- Residential outdoor – identify high-use residential customers and target programs such as water audits, education on landscaping, and rebate programs
- Commercial – encourage appliance upgrades such as toilets, washing machines, and carwash upgrades.

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utilities in Region O. Further details on these

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region O.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
O	6	6	1	2	0	0	0	0	0	0	1	16	2.7

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

How can conservation activity be measured accurately on a large scale to ensure Region O is meeting the marks set out in its regional water plan?

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

---

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).
[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

<u>Savings Quantified by the Utility</u>

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

<u>Accelerated Plumbing Code Savings (PCS)</u>

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections

for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility's service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may

create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Llano Estacado Regional Water Plan recommends that Region O should achieve 5,774 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the six utilities surveyed in this region are estimated to exceed their portion (3,764 acre-feet per year) by 4,190 acre-feet per year. Non-participating municipal WUGs have a WMS supply volume for municipal conservation of 2,010 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region’s participating utilities’ quantified savings estimates are progressing toward meeting their collective 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the six participating utilities. These utilities constitute approximately 55 percent of the region’s population and account for 62 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities

currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	493	944	1,437	1,162	0	1,162	275
2016	888	950	1,838	1,452	0	1,452	386
2017	4,359	955	5,314	1,452	0	1,452	3,862
2018	4,392	961	5,353	1,743	0	1,743	3,610
2019	4,425	966	5,391	2,033	0	2,033	3,358
2020	4,458	972	5,430	2,614	0	2,614	2,816
2021	4,491	983	5,474	2,635	0	2,635	2,839
2022	4,524	994	5,518	2,655	0	2,655	2,862
2023	4,557	1,005	5,562	2,676	0	2,676	2,886
2024	4,591	1,016	5,607	2,697	0	2,697	2,910
2025	4,624	1,027	5,652	2,718	0	2,718	2,934
2026	4,658	1,039	5,697	2,738	0	2,738	2,958
2027	4,692	1,050	5,741	2,759	0	2,759	2,982
2028	4,725	1,061	5,786	2,780	0	2,780	3,006
2029	4,759	1,072	5,831	2,800	0	2,800	3,030
2030	4,792	1,083	5,875	2,821	0	2,821	3,054
2031	4,828	1,094	5,922	2,842	0	2,842	3,080
2032	4,863	1,105	5,968	2,862	0	2,862	3,106
2033	4,898	1,117	6,015	2,883	0	2,883	3,132
2034	4,933	1,128	6,061	2,903	0	2,903	3,158
2035	4,968	1,139	6,107	2,924	0	2,924	3,184
2036	5,004	1,150	6,154	2,944	0	2,944	3,210
2037	5,039	1,161	6,200	2,965	0	2,965	3,236
2038	5,074	1,173	6,247	2,985	0	2,985	3,262
2039	5,109	1,184	6,293	3,006	0	3,006	3,288
2040	5,144	1,195	6,339	3,026	0	3,026	3,313
2041	5,185	1,207	6,392	3,049	0	3,049	3,343
2042	5,226	1,219	6,445	3,073	0	3,073	3,373
2043	5,267	1,232	6,498	3,096	0	3,096	3,402
2044	5,308	1,244	6,551	3,120	0	3,120	3,432
2045	5,348	1,256	6,604	3,143	0	3,143	3,461
2046	5,389	1,268	6,657	3,166	0	3,166	3,491
2047	5,430	1,280	6,710	3,190	0	3,190	3,521
2048	5,471	1,293	6,763	3,213	0	3,213	3,550
2049	5,511	1,305	6,816	3,237	0	3,237	3,580
2050	5,552	1,317	6,869	3,260	0	3,260	3,609
2051	5,595	1,329	6,923	3,284	0	3,284	3,639
2052	5,638	1,340	6,978	3,309	0	3,309	3,669
2053	5,680	1,351	7,032	3,333	0	3,333	3,699
2054	5,723	1,363	7,086	3,357	0	3,357	3,729
2055	5,766	1,374	7,140	3,382	0	3,382	3,758
2056	5,808	1,386	7,194	3,406	0	3,406	3,788
2057	5,851	1,397	7,248	3,430	0	3,430	3,818
2058	5,894	1,409	7,302	3,454	0	3,454	3,848
2059	5,936	1,420	7,357	3,479	0	3,479	3,878
2060	5,979	1,432	7,411	3,503	0	3,503	3,908
2061	6,022	1,443	7,465	3,529	0	3,529	3,936
2062	6,064	1,455	7,519	3,555	0	3,555	3,964
2063	6,107	1,466	7,573	3,581	0	3,581	3,992
2064	6,150	1,478	7,627	3,607	0	3,607	4,020
2065	6,192	1,489	7,681	3,634	0	3,634	4,048
2066	6,235	1,501	7,735	3,660	0	3,660	4,076
2067	6,277	1,512	7,790	3,686	0	3,686	4,104
2068	6,320	1,524	7,844	3,712	0	3,712	4,132
2069	6,363	1,535	7,898	3,738	0	3,738	4,160
2070	6,405	1,546	7,952	3,764	0	3,764	4,190

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
O	Meeting	3	3,007	3	3,268	3	3,538	4	3,847	4	4,165	4	4,465
	Not Meeting	3	(191)	3	(214)	3	(225)	2	(238)	2	(257)	2	(275)
	Total Region O	6	2,816	6	3,054	6	3,313	6	3,609	6	3,908	6	4,190

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Total Regional WMS Volume</u> – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

<u>Unaccounted for Conservation WMS Volume</u> – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

---

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	493	944	1,437	1,868	(432)
2016	888	950	1,838	2,336	(498)
2017	4,359	955	5,314	2,336	2,979
2018	4,392	961	5,353	2,803	2,550
2019	4,425	966	5,391	3,270	2,121
2020	4,458	972	5,430	4,204	1,226
2021	4,491	983	5,474	4,224	1,250
2022	4,524	994	5,518	4,244	1,274
2023	4,557	1,005	5,562	4,264	1,299
2024	4,591	1,016	5,607	4,284	1,324
2025	4,624	1,027	5,652	4,304	1,348
2026	4,658	1,039	5,697	4,323	1,373
2027	4,692	1,050	5,741	4,343	1,398
2028	4,725	1,061	5,786	4,363	1,423
2029	4,759	1,072	5,831	4,383	1,448
2030	4,792	1,083	5,875	4,403	1,472
2031	4,828	1,094	5,922	4,440	1,482
2032	4,863	1,105	5,968	4,477	1,491
2033	4,898	1,117	6,015	4,514	1,500
2034	4,933	1,128	6,061	4,551	1,510
2035	4,968	1,139	6,107	4,589	1,519
2036	5,004	1,150	6,154	4,626	1,528
2037	5,039	1,161	6,200	4,663	1,538
2038	5,074	1,173	6,247	4,700	1,547
2039	5,109	1,184	6,293	4,737	1,556
2040	5,144	1,195	6,339	4,774	1,565
2041	5,185	1,207	6,392	4,804	1,589
2042	5,226	1,219	6,445	4,833	1,612
2043	5,267	1,232	6,498	4,863	1,635
2044	5,308	1,244	6,551	4,893	1,659
2045	5,348	1,256	6,604	4,923	1,682
2046	5,389	1,268	6,657	4,952	1,705
2047	5,430	1,280	6,710	4,982	1,728
2048	5,471	1,293	6,763	5,012	1,752
2049	5,511	1,305	6,816	5,041	1,775
2050	5,552	1,317	6,869	5,071	1,798
2051	5,595	1,329	6,923	5,106	1,818
2052	5,638	1,340	6,978	5,141	1,837
2053	5,680	1,351	7,032	5,175	1,856
2054	5,723	1,363	7,086	5,210	1,876
2055	5,766	1,374	7,140	5,245	1,895
2056	5,808	1,386	7,194	5,280	1,914
2057	5,851	1,397	7,248	5,315	1,934
2058	5,894	1,409	7,302	5,349	1,953
2059	5,936	1,420	7,357	5,384	1,972
2060	5,979	1,432	7,411	5,419	1,992
2061	6,022	1,443	7,465	5,455	2,010
2062	6,064	1,455	7,519	5,490	2,029
2063	6,107	1,466	7,573	5,526	2,048
2064	6,150	1,478	7,627	5,561	2,066
2065	6,192	1,489	7,681	5,597	2,085
2066	6,235	1,501	7,735	5,632	2,103
2067	6,277	1,512	7,790	5,668	2,122
2068	6,320	1,524	7,844	5,703	2,141
2069	6,363	1,535	7,898	5,739	2,159
2070	6,405	1,546	7,952	5,774	2,178

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	944	433		59									1,437
2016	950	827		60									1,838
2017	955	830	3,465	60									5,314
2018	961	834	3,495	61									5,353
2019	966	837	3,524	61									5,391
2020	972	841	3,554	62									5,430
2021	983	844	3,584	62									5,474
2022	994	847	3,613	63									5,518
2023	1,005	851	3,643	64									5,562
2024	1,016	854	3,672	64									5,607
2025	1,027	858	3,702	65									5,652
2026	1,039	861	3,732	65									5,697
2027	1,050	865	3,761	66									5,741
2028	1,061	868	3,791	66									5,786
2029	1,072	872	3,821	67									5,831
2030	1,083	875	3,850	67									5,875
2031	1,094	878	3,881	68									5,922
2032	1,105	881	3,913	69									5,968
2033	1,117	885	3,944	69									6,015
2034	1,128	888	3,975	70									6,061
2035	1,139	891	4,006	71									6,107
2036	1,150	895	4,038	71									6,154
2037	1,161	898	4,069	72									6,200
2038	1,173	901	4,100	73									6,247
2039	1,184	904	4,131	73									6,293
2040	1,195	908	4,163	74									6,339
2041	1,207	911	4,199	75									6,392
2042	1,219	915	4,236	76									6,445
2043	1,232	918	4,272	77									6,498
2044	1,244	922	4,308	77									6,551
2045	1,256	925	4,345	78									6,604
2046	1,268	929	4,381	79									6,657
2047	1,280	933	4,418	80									6,710
2048	1,293	936	4,454	80									6,763
2049	1,305	940	4,491	81									6,816
2050	1,317	943	4,527	82									6,869
2051	1,329	948	4,564	83									6,923
2052	1,340	953	4,601	83									6,978
2053	1,351	958	4,639	84									7,032
2054	1,363	963	4,676	84									7,086
2055	1,374	968	4,713	85									7,140
2056	1,386	972	4,750	86									7,194
2057	1,397	977	4,787	86									7,248
2058	1,409	982	4,824	87									7,302
2059	1,420	987	4,862	88									7,357
2060	1,432	992	4,899	88									7,411
2061	1,443	996	4,936	89									7,465
2062	1,455	1,001	4,974	90									7,519
2063	1,466	1,005	5,011	90									7,573
2064	1,478	1,010	5,049	91									7,627
2065	1,489	1,014	5,086	92									7,681
2066	1,501	1,019	5,124	92									7,735
2067	1,512	1,023	5,161	93									7,790
2068	1,524	1,028	5,199	94									7,844
2069	1,535	1,032	5,237	94									7,898
2070	1,546	1,037	5,274	95									7,952

9 Region O Challenges

Listed below are challenges the LERWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout the Panhandle is relatively low. Traditional municipal conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the LERWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The LERWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something specific for which to strive. Additionally, these utilities could be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities as part of this project.

The LERWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They should also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar data collection projects in the future. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities throughout Texas are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and LERWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the LERWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region O, the most common suggested activities were to install AMI with a customer engagement portal component to help reduce water loss and inform customers about their water use patterns, and to use periodic, strategic water rate increases to reduce consumption.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Statewide Municipal Water Conservation Quantification Project
Report to the Lavaca Regional Water Planning Group
Region P • 2017

1 Executive Summary

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the 2017 State Water Plan. The project was also tasked with identifying activities that participating water utilities could pursue to meet future goals.

In fall of 2016, the TWDB contracted with Averitt & Associates, Inc., to complete the project.

The following tasks were developed under the guidance of the TWDB:

> **Task 1**: Develop an approach to estimate the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 2**: Prepare an assessment of the implementation of recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 3**: Quantitatively determine on an annual pro-rata basis the implementation of recommended municipal water conservation strategies required to meet the water conservation goals in the approved 2016 regional water plans.
>
> **Task 4**: Incorporate the use of the TWDB's Best Management Practices (BMP) Guide as appropriate.
>
> **Task 5**: Review the recommended municipal water conservation strategies in the approved 2016 regional water plans.
>
> **Task 6**: Review the TWDB's 2012 Water Conservation Savings Quantification Study (BBC Research and Consulting, 2012), and incorporate relevant findings as appropriate.

1.1 Key Findings

- The participating utility in Region P makes up approximately 12,000 in population by 2020, which is 24 percent of the region's total projected 2020 population.
- The participating utility makes up 52 percent of the region's recommended 2020 municipal conservation goal (supply volume).

- With the current conservation activities of the one participating water utility in place—and without further enhancement—Region P as a whole is projected to fall short of its recommended 2020 water conservation supply volume by 70 acre-feet per year.
- These conservation savings estimates will fall short of the region's 2070 supply volume by 517 acre-feet per year if no other conservation activities are pursued.
- With the current conservation activities of the one participating water utility in place—and without further enhancement—this utility is projected to exceed its recommended 2020 water conservation supply volume by 30 acre-feet per year.[1]
- Without further activity, this utility is projected exceed its 2025 supply volume by two acre-feet per year, but will fall short of its 2070 volume by 179 acre-feet per year.
- The participating utility employs two measurable conservation activities to achieve these results.

2 Introduction

The State Water Plan divides the state into 16 regions. Each region possesses its own environmental characteristics, demographics, and water supply concerns and develops its own water management strategies that can be used to meet the needs identified throughout the 50-year planning period.

Region P is located along the southeastern Texas coast and consists of all or part of three counties. It is the smallest and least populated planning region. El Campo is the primary population hub. Region P is not considered a rapid growth area of the state.

The Region P Plan states, "[t]he Lavaca Regional Water Planning Group (LRWPG) feels it is important to recommend municipal conservation as a water management strategy to encourage conservation in the region, and to aid municipalities in obtaining funding to perform conservation measures such as leak detection and repair, and installing smart meters." The plan calls for 674 acre-feet per year of savings to come from municipal water conservation by 2070[2] (Texas Water Development Board, 2016n). Water conservation activities and water loss mitigation efforts are combined in this region to arrive at this WMS supply volume for municipal water conservation.

---

[1] See Section 7 for details on number of individual participating utilities in each region meeting and not meeting recommended supply volumes via quantified savings estimates.

[2] This value is the recommended water management strategy supply volume for municipal water conservation. The decadal supply volumes for Region P are 209 acre-feet per year for 2020, 323 acre-feet per year for 2030, 444 acre-feet per year for 2040, 607 acre-feet per year for 2050, and 590 acre-feet per year for 2060.

3 Criteria and Participation

Utilities were targeted for participation in the study using criteria supplied by the TWDB. Utilities that have a five-year water conservation plan on file with the agency, identify municipal conservation as a WMS in their regional water plans, and have a need (shortage) within the first two decades of the planning period were invited to participate in this voluntary project.

Outreach methods included presentations to the regional water planning groups (RWPG), direct introductory emails to appropriate utility staff with an official letter from the TWDB, phone calls, personal visits, and multiple follow-ups. For most utilities, in-person interviews were conducted to complete data collection and the interview process, while over-the-phone interviews and emailed interview responses were used for some smaller utilities.

In Region P, no utilities met these criteria. In order to gain valuable insight about water conservation in Region P, the City of El Campo was contacted and agreed to participate.

This utility represents approximately 24 percent of the 2020 population of Region P and 52 percent of the 2020 WMS supply volume for municipal water conservation for the region.

El Campo received a report on the results of its water conservation activities and water loss efforts and is included as a part of this report. This report summarizes the savings from the individual utility report within Region P.

4 Regional Planning Group Approach to Municipal Water Conservation

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing

- Steam electric power generation

What is a recommended water management strategy?

A recommended WMS is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

4.1 Approach to Determining Supply Volumes

To develop WMS supply volumes for municipal conservation, Region P planners used a target of 140 GPCD,[3] as recommended by the Water Conservation Implementation Task Force. The objective of recommended activities is to reduce demand by five percent per decade for WUGs over 140 GPCD (Texas Water Development Board, 2016n).

4.2 Approach to Meeting Recommended Supply Volumes

Although the Lavaca Regional Water Planning Group (LRWPG) does not specifically recommend any particular municipal water conservation strategies, the following were mentioned:

- Drought tolerant landscape
- Smart water meters
- Public education and outreach
- Rebate and incentive programs
- Local ordinances that increase efficiency

[3] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- Increased water utility efficiency
- Conservation rate structures

For comparison, Table 4-1 illustrates which measurable municipal conservation activities are being implemented by the participating utility in Region P. Further details on these categories of activities, which were the most prevalently implemented throughout the state can be found in Section 8 of this regional report.

Table 4-1. Actual Implemented Activities of Participating Utilities (since 2011) in Region P.

Region	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Activities	Average Per Utility
P	1	1	0	0	0	0	0	0	0	0	0	2	2.0

5 Project Approach

The following question was used as the basis for developing an approach to complete each region's project:

> *How can conservation activity be measured accurately to ensure Region P is meeting the marks set out in its regional water plan?*

A 2012 BBC Research water conservation savings quantification study prepared for the TWDB identified the two primary ways that water providers measure water conservation—top-down and bottom-up.

Using the study's terminology, "[t]op-down refers to estimation approaches based on aggregate water use changes; bottom-up refers to quantification based on adding up savings estimates for individual conservation measures," (BBC Research and Consulting, 2012).

A common top-down approach used by many states—and indeed accomplished by the TWDB via its water conservation annual reports—is to compare gallons per capita per day (GPCD) consumption from year to year, or to compare current year levels with a five-year rolling average.

However, per capita use from utility to utility can vary greatly. A variety of factors may influence GPCD consumption, including climate, population, utility education efforts, building density, customer class makeup, and regional economic conditions. In addition, based on data gathered during the project, it was evident that GPCD values are often misreported and that discrepancies still exist regarding how they are calculated and which baselines to establish.

Quantifying conservation activities using a bottom-up method can help isolate reliable, measurable savings from the sometimes-volatile swings in GPCD levels across utilities.

For regional planners, this is an important advantage to the bottom-up approach. If water conservation savings from quantifiable activities are conservatively estimated and better represent the supply volumes genuinely resulting from conservation efforts, then planning supply volumes from other water management strategies becomes a more realistic endeavor. It essentially helps planning efforts match more closely with the realities on the ground.

The BBC Research study concluded that "…utilities must have estimates of reliable water savings…thus, there is a need for greater focus and standardization in procedures for estimating water savings itself." And, finally, that, "[t]he combination of top-down approaches to evaluate overall usage with bottom-up approaches for program evaluation is likely the best method for comprehensive analysis of conservation savings…" (BBC Research and Consulting, 2012).

Thus, the approach for this project was to establish a uniform, standard method of quantifying savings for all participating utilities, while noting and comparing the water use increase or decrease represented by changes in GPCD consumption levels in their individual utility reports.

6 Methodology

6.1 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[4] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD[5] for that year.[6] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

6.1.1 Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[7] for water loss GPCD[8] and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the process because water loss will inevitably increase or decrease in later years.

---

[4] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[5] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

[6] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[7] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach utilized here was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

6.2 Quantifiable Savings

The key to a project of this type being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

6.2.1 Caveats to specific activity savings

Several activities were encountered but could not be accurately quantified because of unreliable or incomplete savings estimates. For example, neither athletic field, park, nor golf course conservation efforts were included because there was too much variability from utility to utility to be consistent and accurate.

For a few activities, certain assumptions were also made that deserve further explanation because the activities contribute to considerable savings over time.

<u>Water Rate Increases</u>

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, the savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were also made for water rate increases:

- The study assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity study estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Savings Quantified by the Utility

For some large, sophisticated utilities, such as City of Austin, Dallas Water Utilities, and San Antonio Water System, quantified savings estimates were used as the projections. These utilities have multiple staff members dedicated to water conservation and had specific, reliable savings estimates for all of their efforts. Findings showed that uniform savings estimates used throughout the process for other utilities tracked closely with their internal savings figures.

Accelerated Plumbing Code Savings (PCS)

The regional and state water plans have accounted for passive savings that will occur due to the natural replacement of inefficient water fixtures and appliances pursuant to federal and state plumbing code requirements. Some regional water plans expect all passive PCS will be achieved by 2045. By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS. These values should be helpful when planners are assessing future supply volumes that can be expected from these activities.

Activity savings falling under this category were carried forward through 2070 because, due to plumbing code and efficiency standards, these high efficiency fixtures and devices will be replaced by another equally as efficient item. The project considered curbing savings by 2045, but to be consistent with other persistent savings, such as the projections for water rate increases and permanent ordinances, savings were carried through to the end of the planning period. It is also likely that plumbing code and efficiency standards will undergo further revision during this time, which may affect this timeline.

6.2.2 Interactions among conservation activity savings

The 2012 TWDB quantification study identified three types of interaction effects: competitive, independent, and synergistic (BBC and Research, 2012).

> "[Competitive] results in water savings less than the sum of water savings from each measure when implemented alone. For example, a rebate program for installation of water-efficient irrigation systems may be expected to save a certain volume of water. When coupled with passage of outdoor water restrictions, however, savings from the efficient systems may be lower than they would otherwise be (e.g., watering occurs once per week rather than twice, thus overall savings are reduced). [Independent] indicates their savings are strictly additive, such as water use efficiency from a cooling tower retrofit and installation of waterless urinals in a commercial facility. [Synergistic] occurs when two measures result in a combined savings that is greater than the sum of savings if the measures were implemented individually, such as might occur with installation of drought-tolerant plant materials and education on irrigation techniques."

This study primarily encountered competitive savings interactions with outdoor watering measures. With ordinances restricting outdoor watering, there were occasionally other measures in place to enhance or further curb outdoor watering that were not factored into the estimates, such as irrigation controller rebates, stricter ordinance enforcement, and outdoor lawn audits.

6.2.3 Limitations to data collection and the interview process

The projections in this report indicate the best information available, as provided by utility staff. Several times staff-provided data did not match records on file with the TWDB or did not match another staff member's work from previous records.

It is also possible that the report does not account for all ongoing activities. Some activities within a utility’s service area are implemented on a micro-scale that is unquantifiable to date. Individual households and businesses may be implementing unknown, and therefore unquantifiable, conservation measures.

Lastly, staff turnover or delegation over certain data sometimes limited the collection of full interview responses.

6.3 Discrepancies with Regional Water Plan

For individual reports, a utility's service area population was used if there was any difference with WUG population in the regional water plan. When assessing the extent of water conservation activities being implemented by a utility, the following factors may create a discrepancy between this report and the regional or state water plan:

This study focused on the conservation activities employed by utilities within their entire service area. In some cases, service area population and WUG population were the same, but in many cases they were different. Utilities implement conservation activities to the entire area they serve, not just within political boundaries. Therefore, it was logical to track conservation activities based on how many people were affected and to whom the activities were targeted.

Regional splits for population and WMS supply volumes were not used in this report. If a utility is offering service in two different water planning regions, the utility was assigned to the region in which it principally lies. If WMS supply volumes were split between two water planning regions, those volumes were combined and the utilities conservation savings were compared to the total volume. The project's purpose was to assess where the utilities stand in meeting their conservation goals and how can they improve their results. There is little benefit to the utility to know how much conservation is being applied to which region or for the utility to focus on meeting the supply volumes according to the boundaries of different regions.

As a result, the percentage of participating utilities' WMS supply volumes compared to the regional total for WMS supply volumes may be affected by the fact that the water plans adhere to population and WMS supply volumes splits along regional boundaries.

7 Where Does the Region Stand in Meeting Its Municipal Conservation Supply Volumes?

The 2016 Region P Water Plan recommends that Region P should achieve 674 acre-feet per year of savings to meet the 2070 WMS supply volume for municipal water conservation. The results of this study indicate that the utility surveyed in this region is estimated to meet the recommended supply volume for municipal conservation through the year 2025. If no other actions are taken, El Campo is estimated to accrue a deficit of 179 acre-feet per year by 2070. The non-participating municipal WUGs have a WMS supply volume for municipal conservation of 338 acre-feet per year by the end of the planning period.

Table 7-1 shows how the region's participating utility's quantified savings estimates are progressing toward meeting its 2070 future supply volumes for municipal water conservation. The table contains the sum of the supply volumes for the one participating utility. These utilities constitute approximately 24 percent of the region's population and account for 52 percent of this water management strategy.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed in individual reports under the itemized activity. The following definitions pair with the column headers in Table 7-1.

Conservation Activity Savings for Participating Utilities – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

Water Loss Reduction Savings (as of 2015) for Participating Utilities – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[9] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

Total Savings from All Conservation Activity for Participating Utilities – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

Conservation WMS Volume for Participating Utilities – The sum of the recommended municipal water conservation supply volumes in the regional plan for decades ranging from 2020 to 2070 for participating utilities.

Water Loss Reduction WMS Volume for Participating Utilities – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If any of the participating WUGs has a separate WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume for Participating Utilities – The sum of Conservation WMS Volume for Participating Utilities and Water Loss Reduction WMS Volume for Participating Utilities.

Over (Short) – The volume that the participating utilities' total quantified savings estimates for all current conservation activities (since 2011), including water loss reduction, are over or below the recommended total WMS supply volume for municipal water conservation in the regional water plan for those utilities. If the amount falls below the WMS volume, it will appear in parentheses.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 7-1. Participating Utilities' Total Estimated Savings Compared to Participants' Conservation WMS Supply Volumes (in acre-feet per year).

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Conservation WMS Volume for Participating Utilities	Water Loss Reduction WMS Volume for Participating Utilities	Total Yearly WMS Volume for Participating Utilities	Over (Short)
2015	97	41	138	48	0	48	90
2016	98	41	138	61	0	61	78
2017	98	41	138	61	0	61	78
2018	98	41	139	73	0	73	66
2019	98	41	139	85	0	85	54
2020	98	41	139	109	0	109	30
2021	99	41	140	115	0	115	24
2022	99	41	140	121	0	121	19
2023	99	41	140	127	0	127	13
2024	99	41	141	133	0	133	7
2025	100	42	141	140	0	140	2
2026	100	42	142	146	0	146	(4)
2027	100	42	142	152	0	152	(10)
2028	100	42	142	158	0	158	(15)
2029	100	42	143	164	0	164	(21)
2030	101	43	143	170	0	170	(27)
2031	101	43	143	177	0	177	(33)
2032	101	43	144	183	0	183	(40)
2033	101	43	144	190	0	190	(46)
2034	101	43	144	197	0	197	(52)
2035	101	43	145	204	0	204	(59)
2036	101	44	145	210	0	210	(65)
2037	102	44	145	217	0	217	(72)
2038	102	44	146	224	0	224	(78)
2039	102	44	146	230	0	230	(84)
2040	102	44	146	237	0	237	(91)
2041	102	44	147	247	0	247	(100)
2042	103	44	147	256	0	256	(109)
2043	103	45	147	266	0	266	(119)
2044	103	45	148	275	0	275	(128)
2045	103	45	148	285	0	285	(137)
2046	103	45	148	295	0	295	(146)
2047	104	45	149	304	0	304	(156)
2048	104	45	149	314	0	314	(165)
2049	104	45	149	323	0	323	(174)
2050	104	45	150	333	0	333	(183)
2051	104	46	150	333	0	333	(183)
2052	105	46	150	332	0	332	(182)
2053	105	46	151	332	0	332	(181)
2054	105	46	151	331	0	331	(180)
2055	105	46	151	331	0	331	(180)
2056	106	46	152	331	0	331	(179)
2057	106	46	152	330	0	330	(178)
2058	106	46	153	330	0	330	(177)
2059	106	47	153	329	0	329	(176)
2060	107	47	153	329	0	329	(176)
2061	107	47	154	330	0	330	(176)
2062	107	47	154	330	0	330	(176)
2063	107	47	154	331	0	331	(177)
2064	108	47	155	332	0	332	(177)
2065	108	47	155	333	0	333	(177)
2066	108	47	155	333	0	333	(178)
2067	108	47	156	334	0	334	(178)
2068	109	48	156	335	0	335	(178)
2069	109	48	156	335	0	335	(179)
2070	109	48	157	336	0	336	(179)

Table 7-2 lists the number of utilities in the region meeting and not meeting their respective WMS supply volumes via quantified savings assessed in the project. The table shows this comparison for each decade in the planning period from 2020 through 2070, and illustrates how individual participating utilities are progressing toward meeting recommended supply volumes, rather than the region as a whole. As there is only one partipipating utility in this region, the table shows El Campo's decadal results. El Campo is exceeding its 2020 recommended volume by 30 acre-feet per year and falling short through the rest of the planning period.

Table 7-2. Participating Utilities Estimated to be Meeting Respective WMS Supply Volumes.

Region		Number of Utilities	2020 Regional Supply Volumes: Over (Short)	Number of Utilities	2030 Regional Supply Volumes: Over (Short)	Number of Utilities	2040 Regional Supply Volumes: Over (Short)	Number of Utilities	2050 Regional Supply Volumes: Over (Short)	Number of Utilities	2060 Regional Supply Volumes: Over (Short)	Number of Utilities	2070 Regional Supply Volumes: Over (Short)
P	Meeting	1	30		0		0		0		0		0
	Not Meeting		0	1	(27)	1	(91)	1	(183)	1	(176)	1	(179)
	Total Region P	1	30	1	(27)	1	(91)	1	(183)	1	(176)	1	(179)

Table 7-3 shows how the region's participating utilities' quantified savings estimates are progressing toward meeting the entire region's 2070 recommended supply volumes for municipal water conservation. The following definitions pair with the column headers in Table 7-3.

<u>Conservation Activity Savings for Participating Utilities</u> – All quantified activities currently being performed by participating utilities, excluding savings from water loss reduction. The summary of these savings can be referenced in Table 8-1.

<u>Water Loss Reduction Savings (as of 2015) for Participating Utilities</u> – The volume the participating utilities are realizing from water loss reduction. For individual utilities, savings is determined by taking the difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.

<u>Total Savings from All Conservation Activity for Participating Utilities</u> – The sum of Conservation Activity Savings for Participating Utilities and Water Loss Reduction Savings (as of 2015) for Participating Utilities.

<u>Total Regional WMS Volume</u> – The sum of annual WMS supply volumes for municipal water conservation and water loss reduction for the entire region.

<u>Unaccounted for Conservation WMS Volume</u> – The amount that the participating utilities' total quantified savings for all current conservation activities (since 2011), including water loss reduction, is estimated to be over or below the recommended Total Regional WMS Volume. If quantified savings estimates fall below the WMS volume, it will appear in parentheses. This volume is considered unaccounted for because it includes

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the WMS supply volumes for all non-participating municipal WUGs in the region for which savings have not been quantified, as well the volumes for participating utilities that exceed quantified savings estimates.

Table 7-3. Comparison of Quantified Savings of Participating Utilities and Municipal Conservation WMS Supply Volumes for Entire Region.

Year	Conservation Activity Savings for Participating Utilities	Water Loss Reduction Savings (as of 2015) for Participating Utilities	Total Savings from All Conservation Activity for Participating Utilities	Total Regional Yearly WMS Volume	Unaccounted for Conservation WMS Volume
2015	97	41	138	93	45
2016	98	41	138	116	22
2017	98	41	138	116	22
2018	98	41	139	139	(1)
2019	98	41	139	163	(24)
2020	98	41	139	209	(70)
2021	99	41	140	220	(81)
2022	99	41	140	232	(92)
2023	99	41	140	243	(103)
2024	99	41	141	255	(114)
2025	100	42	141	266	(125)
2026	100	42	142	277	(136)
2027	100	42	142	289	(147)
2028	100	42	142	300	(158)
2029	100	42	143	312	(169)
2030	101	43	143	323	(180)
2031	101	43	143	335	(192)
2032	101	43	144	347	(203)
2033	101	43	144	359	(215)
2034	101	43	144	371	(227)
2035	101	43	145	384	(239)
2036	101	44	145	396	(251)
2037	102	44	145	408	(262)
2038	102	44	146	420	(274)
2039	102	44	146	432	(286)
2040	102	44	146	444	(298)
2041	102	44	147	460	(314)
2042	103	44	147	477	(330)
2043	103	45	147	493	(346)
2044	103	45	148	509	(362)
2045	103	45	148	526	(378)
2046	103	45	148	542	(394)
2047	104	45	149	558	(410)
2048	104	45	149	574	(426)
2049	104	45	149	591	(441)
2050	104	45	150	607	(457)
2051	104	46	150	605	(455)
2052	105	46	150	604	(453)
2053	105	46	151	602	(451)
2054	105	46	151	600	(449)
2055	105	46	151	599	(447)
2056	106	46	152	597	(445)
2057	106	46	152	595	(443)
2058	106	46	153	593	(441)
2059	106	47	153	592	(439)
2060	107	47	153	590	(437)
2061	107	47	154	598	(445)
2062	107	47	154	607	(453)
2063	107	47	154	615	(461)
2064	108	47	155	624	(469)
2065	108	47	155	632	(477)
2066	108	47	155	640	(485)
2067	108	47	156	649	(493)
2068	109	48	156	657	(501)
2069	109	48	156	666	(509)
2070	109	48	157	674	(517)

8 Activity Findings

Table 8-1 shows the most prevalently implemented conservation activities in the state. The values in the table show how much these activities are saving specifically in this region.

For specific formulas used to quantify these activities, refer to Section 6 in the State Report as part of this document.

Terms used in Table 8-1:

Water Loss Reduction – The amount of water savings (or loss)[11] due to efforts that reduce leaks and breaks, customer meter inaccuracy, data discrepancies, and other unaccounted-for water.

Water Rate Increases – Strategic increases to a utility's water service rates that result in reduced consumption.

2x Watering Ordinance – An ordinance that permanently restricts outdoor watering schedules to two times per week or less, year-round. Savings are assumed to increase at the same pace as increasing demand over time.

Conservation Pricing – The use of rate structures that discourage the inefficient use or waste of water.

AMI with Customer Portal – These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

Utility Outdoor Irrigation Audits – Audits performed on single-family residences by licensed irrigators that work in-house at the utility. These audits reduce water by surveying current outdoor water use, making recommendations, and occasionally installing or repairing equipment to further curb use. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Vendor Take-home Device Kits – Kits distributed by a third-party vendor to students that include water conserving devices, including showerheads, kitchen and bathroom aerators,

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will be negative because more water is being lost than the baseline amount.

toilet flappers, and leak detectors. Savings for the showerhead in these kits were counted separately from savings in the accelerated PCS category. Each item in the kit is conservatively assumed to have a five-year useful life and an adoption rate of 15 percent for all kits distributed (Frontier Associates, 2015).

Vendor Retrofit Program – Third-party vendor that carries out a program targeting multi-family residential, hotel, and commercial customers. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets, and replacing sink aerators. This program operates outside of the utility's top-down planned efforts and is achieving notable savings, so it was deemed necessary to account for its results. Savings from the toilet-rebuilding portion of the program were counted separately from savings in the accelerated PCS category.

Rainwater Barrels – Barrels and other rainwater collection systems that store rain for later use and replace potable water. A 10-year useful life is assumed for most barrels (GDS Associates, 2002).

Vendor Outdoor Irrigation Audits – Third-party contractor that performs audits on single-family residences similar to those conducted by in-house utility staff. Savings for this activity are assumed to have a 20 percent annual decay rate as consumer behavior and the effectiveness of other audit features lessen over time (A&N Technical Services, 2005).

Accelerated PCS – By offering rebates or other incentives, directly replacing fixtures, or by giving away various items, utilities can accelerate anticipated passive PCS.

Other – Savings from any conservation activities not included in the other categories. All specific savings from these activities are quantified in detail in individual utility reports.

Table 8-1. Savings from Most Widely Used Conservation Activities (in acre-feet).

Year	Water Loss Reduction	Water Rate Increases	2x Watering Ordinance	Conservation Pricing	AMI with Customer Portal	Utility Outdoor Irrigation Audits	Vendor Take-home Device Kits	Vendor Retrofit Program	Rainwater Barrels	Vendor Outdoor Irrigation Audits	Accelerated PCS	Other	Total Savings from All Conservation Activity
2015	41	97											138
2016	41	98											138
2017	41	98											138
2018	41	98											139
2019	41	98											139
2020	41	98											139
2021	41	99											140
2022	41	99											140
2023	41	99											140
2024	41	99											141
2025	42	100											141
2026	42	100											142
2027	42	100											142
2028	42	100											142
2029	42	100											143
2030	43	101											143
2031	43	101											143
2032	43	101											144
2033	43	101											144
2034	43	101											144
2035	43	101											145
2036	44	101											145
2037	44	102											145
2038	44	102											146
2039	44	102											146
2040	44	102											146
2041	44	102											147
2042	44	103											147
2043	45	103											147
2044	45	103											148
2045	45	103											148
2046	45	103											148
2047	45	104											149
2048	45	104											149
2049	45	104											149
2050	45	104											150
2051	46	104											150
2052	46	105											150
2053	46	105											151
2054	46	105											151
2055	46	105											151
2056	46	106											152
2057	46	106											152
2058	46	106											153
2059	47	106											153
2060	47	107											153
2061	47	107											154
2062	47	107											154
2063	47	107											154
2064	47	108											155
2065	47	108											155
2066	47	108											155
2067	47	108											156
2068	48	109											156
2069	48	109											156
2070	48	109											157

9 Region P Challenges

Listed below are challenges the LRWPG and its associated utilities are facing regarding implementing water conservation as a WMS, as identified by this study.

9.1 Regional Communication

- From interview responses, it was made clear that most utilities are largely unaware of impending regional shortages or any recommendations made by the regional water planning group to specifically address municipal conservation.
- Utilities often do not know what their role is regarding regional conservation supply volumes.

9.2 Teamwork and Accomplishment

Residential consumption in small towns throughout Texas is very low. Traditional conservation activities, therefore, are not seen as particularly necessary. It was evident through interviews in less populated towns that the amount of savings that are possible from municipal conservation efforts seems insignificant in relation to the amount of water being used by other sectors, such as agriculture and larger cities, and therefore harder to adopt.

By educating communities on their portion of the regional WMS supply volume for municipal water conservation objectives, they could have a sense of doing their part by achieving reasonable results.

10 Recommendations

Listed below are recommendations for the LRWPG and utilities.

10.1 Participation and Communication

- Utilities should fully participate in the regional water planning process to become knowledgeable about the planning process and provide stakeholder input.
- The LRWPG could educate the utilities in the area about their specific WMS supply volume for municipal water conservation objectives. This gives them something very specific for which to strive. Additionally, these utilities could be informed on what options and activities are available to them and what they can expect to achieve by implementing them. Each participating utility was issued a report that gave general recommendations about how to move forward with municipal conservation activities.

The LRWPG could sponsor stakeholder meetings to keep the issue relevant for these utilities. They could also establish a reliable, efficient communication structure that connects regional planners to all utilities to periodically discuss progress.

10.2 Continue Data Collection

Encourage broader participation in similar data collection projects in the future. Increased participation will be imperative in future years to ensure accuracy, foster a more complete understanding of regional conservation, and achieving regional supply volumes. Continued data collection will make the WMS for municipal conservation an attainable ongoing strategy for the planners. Keeping up with progress will be essential to further development of the strategy. If you can measure it, you can manage it.

10.3 Training and Financing Opportunities

Many utilities in Texas are considering AMI. AMI is a popular and growing activity throughout the state. It represents a new way of informing consumers about their consumption patterns and is a powerful tool to change behavior. Most small utilities do not have the expertise to pursue this option. The TWDB and LRWPG could help those communities take advantage of new technology. Meters must be replaced over time, and AMI could help many municipalities reduce staff overhead along with its water-savings benefits. Perhaps the LRWPG and the TWDB could continue to sponsor training seminars, which should include training on how to access State Water Implementation Fund for Texas (SWIFT) and other TWDB funding programs.

Water planners, managers, and private sector businesses should be educated on the opportunities that Property Assessed Clean Energy (PACE) brings to the water conservation efforts of larger businesses. Many utilities can benefit from their large industrial and commercial customers being more efficient with their water usage. PACE offers a unique way to finance such projects so that they become attractive options. A PACE-financed water conservation project also improves cash flow for the business and saves water.

In order for a private entity to participate in PACE, either the city or county must pass a resolution to participate in the program. Once this is done, the entity has the option to "self-assess" a lien on their property that will allow them to finance a water or energy-saving project over enough time to guarantee a positive cash flow.

10.4 Adopting Activities

Utilities should consider adopting the advanced municipal conservation activities detailed in their individual reports.

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

A detailed cost-benefit analysis on these activities could be performed based upon utility size. The use of specific water purchase and other cost data would also allow for the calculation of savings and cost estimates for these utilities.

For Region P, the suggested activity was to install AMI with a customer portal component to help reduce water loss and inform customers about their water use patterns.

10.5 Additional Resources

Alliance for Water Efficiency
http://www.allianceforwaterefficiency.org

American Water Works Association
https://www.awwa.org

Save Texas Water – Water Conservation Advisory Council
http://www.savetexaswater.org

Texas Water Foundation
http://www.texaswater.org

Water Efficiency Network Trainings
http://www.texaswater.org/ctwen/
https://www.lonestargcd.org/water-efficient/

Intentionally Left Blank

Appendix E - Individual Reports by Region

Region A Individual Reports

Statewide Water Conservation Quantification Project
City of Amarillo Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used By Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2015b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Amarillo's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Amarillo's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Amarillo's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD[6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. This value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Amarillo with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	512	512	251	0	251	261
2016	93	518	611	314	0	314	297
2017	94	524	617	314	0	314	304
2018	95	529	624	377	0	377	247
2019	96	535	630	439	0	439	191
2020	96	541	637	565	0	565	72
2021	97	547	644	572	0	572	72
2022	98	553	651	578	0	578	73
2023	99	559	658	585	0	585	73
2024	100	565	665	591	0	591	74
2025	101	572	672	598	0	598	74
2026	101	578	679	605	0	605	74
2027	102	584	686	611	0	611	75
2028	103	590	693	618	0	618	75
2029	104	596	700	624	0	624	76
2030	105	602	707	631	0	631	76
2031	106	609	715	637	0	637	77
2032	107	615	722	643	0	643	79
2033	107	622	729	649	0	649	80
2034	108	628	736	655	0	655	81
2035	109	634	744	662	0	662	82
2036	110	641	751	668	0	668	83
2037	111	647	758	674	0	674	85
2038	112	654	766	680	0	680	86
2039	113	660	773	686	0	686	87
2040	114	666	780	692	0	692	88
2041	115	673	788	698	0	698	89
2042	116	679	795	705	0	705	90
2043	117	686	803	711	0	711	92
2044	118	692	810	717	0	717	93
2045	119	699	817	724	0	724	94
2046	120	705	825	730	0	730	95
2047	121	711	832	736	0	736	96
2048	122	718	840	742	0	742	97
2049	123	724	847	749	0	749	98
2050	124	731	854	755	0	755	99
2051	125	738	863	762	0	762	100
2052	126	745	871	769	0	769	101
2053	127	752	879	776	0	776	102
2054	128	758	887	783	0	783	103
2055	129	765	895	791	0	791	104
2056	131	772	903	798	0	798	105
2057	132	779	911	805	0	805	106
2058	133	786	919	812	0	812	107
2059	134	793	927	819	0	819	108
2060	135	800	935	826	0	826	109
2061	136	807	944	833	0	833	110
2062	137	815	952	841	0	841	111
2063	139	822	961	848	0	848	112
2064	140	829	969	856	0	856	113
2065	141	836	977	863	0	863	114
2066	142	844	986	870	0	870	116
2067	143	851	994	878	0	878	117
2068	145	858	1,003	885	0	885	118
2069	146	866	1,011	893	0	893	119
2070	147	873	1,020	900	0	900	120

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Amarillo's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	227	0	0	0
1	2015	200,502	217	761	512	(249)
2	2016	202,720	206	1,539	611	(928)
3	2017	204,938	196	2,334	617	(1,716)
4	2018	207,155	185	3,145	624	(2,522)
5-year Goal	2019	209,373	175	3,974	630	(3,343)
6	2020	211,591	174	4,093	637	(3,456)
7	2021	214,013	173	4,218	644	(3,574)
8	2022	216,434	172	4,345	651	(3,694)
9	2023	218,856	171	4,473	658	(3,815)
10-year Goal	2024	221,277	170	4,604	665	(3,939)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Amarillo's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-3.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	200,502	15.00	0	512	512
2	2016	202,720	15.00	0	518	518
3	2017	204,938	15.00	0	524	524
4	2018	207,155	15.00	0	529	529
5-year Goal	2019	209,373	15.00	0	535	535
6	2020	211,591	14.40	46	541	494
7	2021	214,013	13.80	94	547	453
8	2022	216,434	13.20	142	553	411
9	2023	218,856	12.60	192	559	367
10-year Goal	2024	221,277	12.00	242	565	323

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of 512 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent five-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[16]
        i. 3% increase in 2016
    b. Estimated customer demand reduction of 0.6%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Rain Barrels**
    a. In Region A, estimated savings of 12.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

6. **Save Water Co. Commercial, Multi-family and Hotel Programs**[18]

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted five-year water conservation plan, the historic five-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[18] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

a. Project initiated in service area in March 2016
b. Save Water completed work on 120 multi-family units in 2016.
c. Average monthly savings of 235,668 gallons
d. Annualized savings of 2.83 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Rain Barrels	Save Water Co. Program	TOTAL SAVINGS
2016	90	0.21	3	93.0
2017	91	0.21	3	93.8
2018	92	0.21	3	94.7
2019	92	0.21	3	95.5
2020	93	0.21	3	96.4
2021	94	0.21	3	97.2
2022	95	0.21	3	98.1
2023	96	0.21	3	98.9
2024	97	0.21	3	99.8
2025	98	0.21	3	100.7
2026	98		3	101.3
2027	99		3	102.2
2028	100		3	103.0
2029	101		3	103.9
2030	102		3	104.7
2031	103		3	105.6
2032	104		3	106.6
2033	105		3	107.5
2034	106		3	108.4
2035	106		3	109.3
2036	107		3	110.2
2037	108		3	111.2
2038	109		3	112.1
2039	110		3	113.0
2040	111		3	113.9
2041	112		3	114.9
2042	113		3	115.9
2043	114		3	116.9
2044	115		3	117.9
2045	116		3	118.9
2046	117		3	119.8
2047	118		3	120.8
2048	119		3	121.8
2049	120		3	122.8
2050	121		3	123.8
2051	122		3	124.9
2052	123		3	126.0
2053	124		3	127.2
2054	125		3	128.3
2055	127		3	129.4
2056	128		3	130.6
2057	129		3	131.7
2058	130		3	132.8
2059	131		3	133.9
2060	132		3	135.1
2061	133		3	136.3
2062	135		3	137.5
2063	136		3	138.7
2064	137		3	139.9
2065	138		3	141.0
2066	139		3	142.2
2067	141		3	143.4
2068	142		3	144.6
2069	143		3	145.8
2070	144		3	147.0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	200,502	8.00	512
2016	202,720	8.00	518
2017	204,938	8.00	524
2018	207,155	8.00	529
2019	209,373	8.00	535
2020	211,591	8.00	541
2021	214,013	8.00	547
2022	216,434	8.00	553
2023	218,856	8.00	559
2024	221,277	8.00	565

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 8.63% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    b. Savings could be 1,293 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	93	518	611	1,293	314	0	314	1,590
2017	94	524	617	1,305	314	0	314	1,609
2018	95	529	624	1,318	377	0	377	1,565
2019	96	535	630	1,330	439	0	439	1,521
2020	96	541	637	1,342	565	0	565	1,414
2021	97	547	644	1,355	572	0	572	1,427
2022	98	553	651	1,367	578	0	578	1,440
2023	99	559	658	1,379	585	0	585	1,453
2024	100	565	665	1,392	591	0	591	1,465
2025	101	572	672	1,404	598	0	598	1,478
2026	101	578	679	1,416	605	0	605	1,491
2027	102	584	686	1,429	611	0	611	1,504
2028	103	590	693	1,441	618	0	618	1,516
2029	104	596	700	1,453	624	0	624	1,529
2030	105	602	707	1,466	631	0	631	1,542
2031	106	609	715	1,479	637	0	637	1,556
2032	107	615	722	1,492	643	0	643	1,571
2033	107	622	729	1,505	649	0	649	1,585
2034	108	628	736	1,518	655	0	655	1,599
2035	109	634	744	1,532	662	0	662	1,614
2036	110	641	751	1,545	668	0	668	1,628
2037	111	647	758	1,558	674	0	674	1,643
2038	112	654	766	1,571	680	0	680	1,657
2039	113	660	773	1,585	686	0	686	1,672
2040	114	666	780	1,598	692	0	692	1,686

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]
g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	93	518	611	201	314	0	314	498
2017	94	524	617	203	314	0	314	506
2018	95	529	624	205	377	0	377	452
2019	96	535	630	207	439	0	439	398
2020	96	541	637	208	565	0	565	280
2021	97	547	644	210	572	0	572	283
2022	98	553	651	212	578	0	578	285
2023	99	559	658	214	585	0	585	288
2024	100	565	665	216	591	0	591	290
2025	101	572	672	218	598	0	598	292
2026	101	578	679	220	605	0	605	294
2027	102	584	686	222	611	0	611	297
2028	103	590	693	224	618	0	618	299
2029	104	596	700	226	624	0	624	301
2030	105	602	707	228	631	0	631	304
2031	106	609	715	230	637	0	637	307
2032	107	615	722	232	643	0	643	310
2033	107	622	729	234	649	0	649	314
2034	108	628	736	236	655	0	655	317
2035	109	634	744	238	662	0	662	320
2036	110	641	751	240	668	0	668	323
2037	111	647	758	242	674	0	674	327
2038	112	654	766	244	680	0	680	330
2039	113	660	773	246	686	0	686	333
2040	114	666	780	248	692	0	692	336

Statewide Water Conservation Quantification Project
City of Borger Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Borger's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Borger's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Borger's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD[6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility’s service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Borger with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

This table compares all quantified conservation activity starting in 2015 and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).[11]

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If the utility's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	34	34	15	0	15	19
2016	0	34	34	19	0	19	15
2017	0	34	34	19	0	19	16
2018	0	35	35	23	0	23	12
2019	0	35	35	26	0	26	8
2020	0	35	35	34	0	34	1
2021	0	35	35	34	0	34	1
2022	0	35	35	34	0	34	1
2023	0	35	35	34	0	34	1
2024	0	36	36	34	0	34	1
2025	0	36	36	34	0	34	1
2026	0	36	36	34	0	34	1
2027	0	36	36	35	0	35	1
2028	0	36	36	35	0	35	1
2029	0	36	36	35	0	35	1
2030	0	36	36	35	0	35	1
2031	0	36	36	35	0	35	1
2032	0	36	36	35	0	35	2
2033	0	36	36	35	0	35	2
2034	0	36	36	35	0	35	2
2035	0	37	37	35	0	35	2
2036	0	37	37	35	0	35	2
2037	0	37	37	35	0	35	2
2038	0	37	37	35	0	35	2
2039	0	37	37	35	0	35	2
2040	0	37	37	35	0	35	2
2041	0	37	37	35	0	35	2
2042	0	37	37	35	0	35	2
2043	0	37	37	35	0	35	2
2044	0	37	37	35	0	35	2
2045	0	37	37	35	0	35	2
2046	0	37	37	35	0	35	2
2047	0	37	37	35	0	35	2
2048	0	37	37	35	0	35	2
2049	0	37	37	35	0	35	2
2050	0	37	37	35	0	35	2
2051	0	37	37	35	0	35	2
2052	0	37	37	35	0	35	2
2053	0	37	37	35	0	35	2
2054	0	37	37	35	0	35	2
2055	0	37	37	35	0	35	2
2056	0	37	37	35	0	35	2
2057	0	37	37	35	0	35	2
2058	0	37	37	35	0	35	2
2059	0	37	37	35	0	35	2
2060	0	37	37	35	0	35	2
2061	0	37	37	35	0	35	2
2062	0	37	37	35	0	35	2
2063	0	37	37	35	0	35	2
2064	0	37	37	35	0	35	2
2065	0	37	37	35	0	35	2
2066	0	37	37	35	0	35	2
2067	0	37	37	35	0	35	2
2068	0	37	37	35	0	35	2
2069	0	37	37	35	0	35	2
2070	0	37	37	35	0	35	2

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Borger's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	589	0	0	0
1	2015	13,251	624	(171)	34	205
2	2016	13,348	660	(345)	34	379
3	2017	13,444	695	(521)	34	555
4	2018	13,541	731	(700)	35	734
5-year Goal	2019	13,637	766	(881)	35	916
6	2020	13,734	763	(871)	35	906
7	2021	13,783	760	(858)	35	893
8	2022	13,832	756	(845)	35	881
9	2023	13,882	753	(832)	35	867
10-year Goal	2024	13,931	750	(819)	36	854

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Borger's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	25.00	0	0	0
1	2015	13,251	26.40	(7)	34	41
2	2016	13,348	27.80	(14)	34	48
3	2017	13,444	29.20	(21)	34	55
4	2018	13,541	30.60	(28)	35	62
5-year Goal	2019	13,637	32.00	(35)	35	70
6	2020	13,734	30.60	(28)	35	63
7	2021	13,783	29.20	(21)	35	56
8	2022	13,832	27.80	(14)	35	49
9	2023	13,882	26.40	(7)	35	43
10-year Goal	2024	13,931	25.00	0	36	36

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of 34 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	25.00	0
2015	13,251	18.00	34
2016	13,348	18.00	34
2017	13,444	18.00	34
2018	13,541	18.00	35
2019	13,637	18.00	35
2020	13,734	18.00	35
2021	13,783	18.00	35
2022	13,832	18.00	35
2023	13,882	18.00	35
2024	13,931	18.00	36

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[16]

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	34	34	14	19	0	19	29
2017	0	34	34	14	19	0	19	30
2018	0	35	35	14	23	0	23	26
2019	0	35	35	14	26	0	26	23
2020	0	35	35	14	34	0	34	15
2021	0	35	35	14	34	0	34	15
2022	0	35	35	14	34	0	34	15
2023	0	35	35	14	34	0	34	15
2024	0	36	36	14	34	0	34	15
2025	0	36	36	14	34	0	34	15
2026	0	36	36	14	34	0	34	16
2027	0	36	36	14	35	0	35	16
2028	0	36	36	14	35	0	35	16
2029	0	36	36	14	35	0	35	16
2030	0	36	36	14	35	0	35	16
2031	0	36	36	14	35	0	35	16
2032	0	36	36	14	35	0	35	16
2033	0	36	36	14	35	0	35	16
2034	0	36	36	14	35	0	35	16
2035	0	37	37	14	35	0	35	16
2036	0	37	37	14	35	0	35	16
2037	0	37	37	14	35	0	35	16
2038	0	37	37	14	35	0	35	16
2039	0	37	37	14	35	0	35	16
2040	0	37	37	14	35	0	35	16

[16] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

2. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 21 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	34	34	21	19	0	19	36
2017	0	34	34	21	19	0	19	36
2018	0	35	35	21	23	0	23	33
2019	0	35	35	21	26	0	26	29
2020	0	35	35	21	34	0	34	22
2021	0	35	35	21	34	0	34	22
2022	0	35	35	21	34	0	34	22
2023	0	35	35	21	34	0	34	22
2024	0	36	36	21	34	0	34	22
2025	0	36	36	21	34	0	34	22
2026	0	36	36	21	34	0	34	22
2027	0	36	36	21	35	0	35	23
2028	0	36	36	21	35	0	35	23
2029	0	36	36	21	35	0	35	23
2030	0	36	36	21	35	0	35	23
2031	0	36	36	21	35	0	35	23
2032	0	36	36	21	35	0	35	23
2033	0	36	36	21	35	0	35	23
2034	0	36	36	21	35	0	35	23
2035	0	37	37	21	35	0	35	23
2036	0	37	37	21	35	0	35	23
2037	0	37	37	21	35	0	35	23
2038	0	37	37	21	35	0	35	23
2039	0	37	37	21	35	0	35	23
2040	0	37	37	21	35	0	35	23

[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Dalhart Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Dalhart's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Dalhart's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Dalhart's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Dalhart with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

This table compares all quantified conservation activity starting in 2015 and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).[12] Refer to Tables 5-1 and 5-2 for details on these savings.

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If the utility's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(134)	(134)	11	0	11	(146)
2016	6.7	(136)	(129)	14	0	14	(143)
2017	6.8	(137)	(130)	14	0	14	(145)
2018	6.8	(139)	(132)	17	0	17	(149)
2019	6.9	(140)	(133)	20	0	20	(153)
2020	7.0	(141)	(134)	26	0	26	(160)
2021	7.0	(143)	(136)	26	0	26	(162)
2022	7.1	(144)	(137)	26	0	26	(163)
2023	7.1	(146)	(138)	26	0	26	(165)
2024	7.2	(147)	(140)	27	0	27	(166)
2025	7.2	(148)	(141)	27	0	27	(168)
2026	7.3	(150)	(142)	27	0	27	(169)
2027	7.4	(151)	(144)	27	0	27	(171)
2028	7.4	(152)	(145)	28	0	28	(173)
2029	7.5	(154)	(146)	28	0	28	(174)
2030	7.5	(155)	(148)	28	0	28	(176)
2031	7.6	(157)	(149)	28	0	28	(177)
2032	7.6	(158)	(150)	28	0	28	(179)
2033	7.7	(159)	(152)	29	0	29	(180)
2034	7.8	(161)	(153)	29	0	29	(182)
2035	7.8	(162)	(154)	29	0	29	(183)
2036	7.9	(163)	(156)	29	0	29	(185)
2037	7.9	(165)	(157)	30	0	30	(186)
2038	8.0	(166)	(158)	30	0	30	(188)
2039	8.1	(167)	(159)	30	0	30	(190)
2040	8.1	(169)	(161)	30	0	30	(191)
2041	8.2	(170)	(162)	31	0	31	(193)
2042	8.2	(172)	(163)	31	0	31	(194)
2043	8.3	(173)	(165)	31	0	31	(196)
2044	8.3	(174)	(166)	31	0	31	(197)
2045	8.4	(175)	(167)	31	0	31	(199)
2046	8.5	(177)	(168)	32	0	32	(200)
2047	8.5	(178)	(170)	32	0	32	(202)
2048	8.6	(179)	(171)	32	0	32	(203)
2049	8.6	(181)	(172)	32	0	32	(204)
2050	8.7	(182)	(173)	33	0	33	(206)
2051	8.8	(183)	(175)	33	0	33	(207)
2052	8.8	(185)	(176)	33	0	33	(209)
2053	8.9	(186)	(177)	33	0	33	(210)
2054	8.9	(187)	(178)	34	0	34	(212)
2055	9.0	(188)	(179)	34	0	34	(213)
2056	9.0	(190)	(181)	34	0	34	(215)
2057	9.1	(191)	(182)	34	0	34	(216)
2058	9.2	(192)	(183)	34	0	34	(217)
2059	9.2	(193)	(184)	35	0	35	(219)
2060	9.3	(195)	(185)	35	0	35	(220)
2061	9.3	(196)	(187)	35	0	35	(222)
2062	9.4	(197)	(188)	35	0	35	(223)
2063	9.4	(198)	(189)	35	0	35	(224)
2064	9.5	(200)	(190)	36	0	36	(226)
2065	9.6	(201)	(191)	36	0	36	(227)
2066	9.6	(202)	(192)	36	0	36	(228)
2067	9.7	(203)	(194)	36	0	36	(230)
2068	9.7	(204)	(195)	36	0	36	(231)
2069	9.8	(206)	(196)	37	0	37	(232)
2070	9.9	(207)	(197)	37	0	37	(234)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Canyon's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	202	0	0	0
1	2015	8,370	194	26	(134)	(160)
2	2016	8,456	185	52	(129)	(181)
3	2017	8,543	177	79	(130)	(209)
4	2018	8,629	168	106	(132)	(238)
5-year Goal	2019	8,716	160	134	(133)	(267)
6	2020	8,802	156	148	(134)	(282)
7	2021	8,888	152	162	(136)	(298)
8	2022	8,974	148	177	(137)	(314)
9	2023	9,061	144	192	(138)	(330)
10-year Goal	2024	9,147	140	207	(140)	(347)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Dalhart's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
Baseline	-	16.00	0	0	0
2015	8,370	14.80	4	(134)	(138)
2016	8,456	13.60	7	(136)	(143)
2017	8,543	12.40	11	(137)	(148)
2018	8,629	11.20	15	(139)	(154)
2019	8,716	10.00	19	(140)	(159)
2020	8,802	9.00	22	(141)	(164)
2021	8,888	8.00	26	(143)	(169)
2022	8,974	7.00	29	(144)	(174)
2023	9,061	6.00	33	(146)	(179)
2024	9,147	5.00	37	(147)	(184)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 134 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 9% increase in 2016
    b. Estimated customer demand reduction of 1.8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2016	6.7	6.7
2017	6.8	6.8
2018	6.8	6.8
2019	6.9	6.9
2020	7.0	7.0
2021	7.0	7.0
2022	7.1	7.1
2023	7.1	7.1
2024	7.2	7.2
2025	7.2	7.2
2026	7.3	7.3
2027	7.4	7.4
2028	7.4	7.4
2029	7.5	7.5
2030	7.5	7.5
2031	7.6	7.6
2032	7.6	7.6
2033	7.7	7.7
2034	7.8	7.8
2035	7.8	7.8
2036	7.9	7.9
2037	7.9	7.9
2038	8.0	8.0
2039	8.1	8.1
2040	8.1	8.1
2041	8.2	8.2
2042	8.2	8.2
2043	8.3	8.3
2044	8.3	8.3
2045	8.4	8.4
2046	8.5	8.5
2047	8.5	8.5
2048	8.6	8.6
2049	8.6	8.6
2050	8.7	8.7
2051	8.8	8.8
2052	8.8	8.8
2053	8.9	8.9
2054	8.9	8.9
2055	9.0	9.0
2056	9.0	9.0
2057	9.1	9.1
2058	9.2	9.2
2059	9.2	9.2
2060	9.3	9.3
2061	9.3	9.3
2062	9.4	9.4
2063	9.4	9.4
2064	9.5	9.5
2065	9.6	9.6
2066	9.6	9.6
2067	9.7	9.7
2068	9.7	9.7
2069	9.8	9.8
2070	9.9	9.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16	0
2015	8,370	60	(134)
2016	8,456	60	(136)
2017	8,543	60	(137)
2018	8,629	60	(139)
2019	8,716	60	(140)
2020	8,802	60	(141)
2021	8,888	60	(143)
2022	8,974	60	(144)
2023	9,061	60	(146)
2024	9,147	60	(147)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	(136)	(129)	11	14	0	14	(132)
2017	7	(137)	(130)	11	14	0	14	(133)
2018	7	(139)	(132)	11	17	0	17	(137)
2019	7	(140)	(133)	12	20	0	20	(142)
2020	7	(141)	(134)	12	26	0	26	(148)
2021	7	(143)	(136)	12	26	0	26	(150)
2022	7	(144)	(137)	12	26	0	26	(151)
2023	7	(146)	(138)	12	26	0	26	(153)
2024	7	(147)	(140)	12	27	0	27	(154)
2025	7	(148)	(141)	12	27	0	27	(156)
2026	7	(150)	(142)	12	27	0	27	(157)
2027	7	(151)	(144)	12	27	0	27	(159)
2028	7	(152)	(145)	12	28	0	28	(160)
2029	7	(154)	(146)	13	28	0	28	(162)
2030	8	(155)	(148)	13	28	0	28	(163)
2031	8	(157)	(149)	13	28	0	28	(165)
2032	8	(158)	(150)	13	28	0	28	(166)
2033	8	(159)	(152)	13	29	0	29	(167)
2034	8	(161)	(153)	13	29	0	29	(169)
2035	8	(162)	(154)	13	29	0	29	(170)
2036	8	(163)	(156)	13	29	0	29	(172)
2037	8	(165)	(157)	13	30	0	30	(173)
2038	8	(166)	(158)	13	30	0	30	(175)
2039	8	(167)	(159)	13	30	0	30	(176)
2040	8	(169)	(161)	14	30	0	30	(177)

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

Statewide Water Conservation Quantification Project

City of Canyon Report • 2017

Deleted: TWDB

1 Introduction

Formatted: Font:12 pt

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

Deleted: to be

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

Formatted: Font:12 pt

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Formatted: Font:12 pt

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

Deleted: 5

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

Formatted: Font:12 pt

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Deleted: we

Deleted: d

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Deleted: We

Deleted: then quantified

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Deleted: Individual reports distributed to each participating utility detail these attributes.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

Formatted: Font:12 pt

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

Formatted: Font:12 pt

This report compares Canyon's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Canyon's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Canyon's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

Deleted: we

Deleted: have

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Canyon with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

This table compares all quantified conservation activity starting in 2015 and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

Deleted: We are not aware of all activities that are ongoing

Deleted: . Some activities

Deleted: we cannot yet quantify

Deleted: we

Deleted: do not know about and

Deleted: our

Deleted: we used

Deleted: we

Deleted: have

Deleted: our model

Deleted: Our

Formatted: Font:12 pt

Formatted: Font:12 pt

Formatted: Font:12 pt

Formatted: Font:12 pt

Deleted: a

Deleted: Because t

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).[12] Refer to Tables 5-1 and 5-2 for details on these savings.

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If the utility's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

Deleted: we

Deleted: have

Deleted: d

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4.5	83	87	18	0	18	69
2016	15.9	84	100	23	0	23	77
2017	25.3	84	110	23	0	23	87
2018	25.5	85	111	28	0	28	83
2019	25.8	86	112	32	0	32	79
2020	26.0	86	112	41	0	41	71
2021	26.3	87	114	42	0	42	72
2022	26.5	88	115	42	0	42	73
2023	26.8	90	116	43	0	43	73
2024	27.1	91	118	43	0	43	74
2025	27.3	92	119	44	0	44	75
2026	27.6	93	120	44	0	44	76
2027	27.8	94	121	45	0	45	77
2028	28.1	95	123	45	0	45	77
2029	28.3	96	124	46	0	46	78
2030	28.6	97	125	46	0	46	79
2031	28.8	98	126	47	0	47	80
2032	29.1	99	128	47	0	47	81
2033	29.3	100	129	48	0	48	81
2034	29.6	101	130	48	0	48	82
2035	29.8	102	132	49	0	49	83
2036	30.1	103	133	49	0	49	84
2037	30.3	104	134	49	0	49	85
2038	30.6	105	135	50	0	50	85
2039	30.8	106	137	50	0	50	86
2040	31.1	107	138	51	0	51	87
2041	31.3	108	139	51	0	51	88
2042	31.6	109	141	52	0	52	89
2043	31.8	110	142	52	0	52	90
2044	32.1	111	143	53	0	53	90
2045	32.3	112	144	53	0	53	91
2046	32.6	113	146	54	0	54	92
2047	32.8	114	147	54	0	54	93
2048	33.1	115	148	55	0	55	94
2049	33.3	116	150	55	0	55	94
2050	33.6	117	151	56	0	56	95
2051	33.8	118	152	56	0	56	96
2052	34.1	120	154	57	0	57	97
2053	34.3	121	155	57	0	57	98
2054	34.6	122	156	58	0	58	99
2055	34.8	123	158	58	0	58	99
2056	35.1	124	159	59	0	59	100
2057	35.3	125	161	59	0	59	101
2058	35.6	126	162	60	0	60	102
2059	35.8	127	163	60	0	60	103
2060	36.1	129	165	61	0	61	104
2061	36.3	130	166	61	0	61	105
2062	36.6	131	167	62	0	62	105
2063	36.8	132	169	63	0	63	106
2064	37.1	133	170	63	0	63	107
2065	37.3	134	172	64	0	64	108
2066	37.6	135	173	64	0	64	109
2067	37.8	137	174	65	0	65	110
2068	38.1	138	176	65	0	65	111
2069	38.3	139	177	66	0	66	112
2070	38.6	140	179	66	0	66	113

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

3.2 Utility Water Conservation Plan Goals – Total GPCD

Formatted: Font:12 pt

Table 3-2 shows how Canyon's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Deleted: 5-

Deleted: and

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Deleted: 5-

Deleted: 5

Deleted: 5

Deleted: 5

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	178	0	0	0
1	2015	14,200	176	8	87	79
2	2016	14,321	175	17	100	83
3	2017	14,441	173	25	110	84
4	2018	14,562	172	34	111	77
5-year Goal	2019	14,682	170	43	112	69
6	2020	14,803	169	49	112	64
7	2021	14,978	168	55	114	59
8	2022	15,153	167	61	115	54
9	2023	15,328	166	67	116	49
10-year Goal	2024	15,503	165	74	118	44

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Formatted: Font:12 pt

Table 3-3 shows how Canyon's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Deleted: 5

Deleted: 5

Deleted: 5

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	32.00	0	0	0
1	2015	14,200	30.60	7	83	76
2	2016	14,321	29.20	15	84	69
3	2017	14,441	27.80	22	84	62
4	2018	14,562	26.40	30	85	55
5-year Goal	2019	14,682	25.00	38	86	48
6	2020	14,803	24.00	43	86	43
7	2021	14,978	23.00	49	87	38
8	2022	15,153	22.00	55	88	33
9	2023	15,328	21.00	62	90	28
10-year Goal	2024	15,503	20.00	68	91	23

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

4 Implemented Activities

Formatted: Font:12 pt

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

Deleted: During the project, we were able to

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

Deleted: we used

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

4.1 Itemized Activities

Formatted: Font:12 pt

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 83 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last three rate increases:[17]
        i. 2% increase in 2015
        ii. 5% increase in 2016
        iii. 4% increase in 2017
    b. Estimated customer demand reduction of 2.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

15 If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
16 In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
17 Correspondence with utility staff.
18 The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Deleted: We

Deleted: we can

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

5 Summary of Savings

Formatted: Font:12 pt

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2014	0.0	0.0
2015	4.5	4.5
2016	15.9	15.9
2017	25.3	25.3
2018	25.5	25.5
2019	25.8	25.8
2020	26.0	26.0
2021	26.3	26.3
2022	26.5	26.5
2023	26.8	26.8
2024	27.1	27.1
2025	27.3	27.3
2026	27.6	27.6
2027	27.8	27.8
2028	28.1	28.1
2029	28.3	28.3
2030	28.6	28.6
2031	28.8	28.8
2032	29.1	29.1
2033	29.3	29.3
2034	29.6	29.6
2035	29.8	29.8
2036	30.1	30.1
2037	30.3	30.3
2038	30.6	30.6
2039	30.8	30.8
2040	31.1	31.1
2041	31.3	31.3
2042	31.6	31.6
2043	31.8	31.8
2044	32.1	32.1
2045	32.3	32.3
2046	32.6	32.6
2047	32.8	32.8
2048	33.1	33.1
2049	33.3	33.3
2050	33.6	33.6
2051	33.8	33.8
2052	34.1	34.1
2053	34.3	34.3
2054	34.6	34.6
2055	34.8	34.8
2056	35.1	35.1
2057	35.3	35.3
2058	35.6	35.6
2059	35.8	35.8
2060	36.1	36.1
2061	36.3	36.3
2062	36.6	36.6
2063	36.8	36.8
2064	37.1	37.1
2065	37.3	37.3
2066	37.6	37.6
2067	37.8	37.8
2068	38.1	38.1
2069	38.3	38.3
2070	38.6	38.6

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	32	0
2015	14,200	16	83
2016	14,321	16	84
2017	14,441	16	84
2018	14,562	16	85
2019	14,682	16	86
2020	14,803	16	86
2021	14,978	16	87
2022	15,153	16	88
2023	15,328	16	90
2024	15,503	16	91

6 Suggested Activities

Formatted: Font:12 pt

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

Formatted: Font:12 pt

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Deleted: Prepared by Averitt & Associates, Inc. for the Texas Water Development Board

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	16	84	100	15	23	0	23	92
2017	25	84	110	15	23	0	23	102
2018	26	85	111	16	28	0	28	99
2019	26	86	112	16	32	0	32	95
2020	26	86	112	16	41	0	41	87
2021	26	87	114	16	42	0	42	88
2022	27	88	115	16	42	0	42	89
2023	27	90	116	16	43	0	43	90
2024	27	91	118	16	43	0	43	91
2025	27	92	119	17	44	0	44	92
2026	28	93	120	17	44	0	44	93
2027	28	94	121	17	45	0	45	94
2028	28	95	123	17	45	0	45	94
2029	28	96	124	17	46	0	46	95
2030	29	97	125	17	46	0	46	96
2031	29	98	126	18	47	0	47	97
2032	29	99	128	18	47	0	47	98
2033	29	100	129	18	48	0	48	99
2034	30	101	130	18	48	0	48	100
2035	30	102	132	18	49	0	49	101
2036	30	103	133	18	49	0	49	102
2037	30	104	134	18	49	0	49	103
2038	31	105	135	19	50	0	50	104
2039	31	106	137	19	50	0	50	105
2040	31	107	138	19	51	0	51	106

2. Employ efforts to maintain water loss volumes near baseline level or below.
3. In the future, as your utility finds water and/or wastewater service rate increases necessary, such pricing signals should continue to be effective in reducing demand.

Statewide Water Conservation Quantification Project
City of Dumas Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Dumas's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Dumas's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Dumas's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility’s service area are implemented on a micro-scale that may not be quantified. Individual households

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Dumas with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

This table compares all quantified conservation activity starting in 2015 and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).[12] Refer to Tables 5-1 and 5-2 for details on these savings.

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If the utility's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	219	(11)	208	19	0	19	189
2016	222	(11)	211	24	0	24	187
2017	225	(12)	213	24	0	24	189
2018	227	(12)	215	29	0	29	187
2019	230	(12)	218	34	0	34	184
2020	233	(12)	220	43	0	43	177
2021	235	(13)	223	44	0	44	179
2022	238	(13)	225	45	0	45	180
2023	240	(13)	228	45	0	45	182
2024	243	(13)	230	46	0	46	184
2025	246	(13)	232	46	0	46	186
2026	248	(13)	235	47	0	47	188
2027	251	(14)	237	48	0	48	190
2028	253	(14)	240	48	0	48	191
2029	256	(14)	242	49	0	49	193
2030	259	(14)	245	50	0	50	195
2031	262	(14)	247	50	0	50	197
2032	265	(14)	250	51	0	51	199
2033	268	(15)	253	51	0	51	202
2034	270	(15)	256	52	0	52	204
2035	273	(15)	258	53	0	53	206
2036	276	(15)	261	53	0	53	208
2037	279	(15)	264	54	0	54	210
2038	282	(16)	267	54	0	54	212
2039	285	(16)	269	55	0	55	214
2040	288	(16)	272	56	0	56	216
2041	291	(16)	275	56	0	56	219
2042	294	(16)	278	57	0	57	221
2043	297	(16)	281	58	0	58	223
2044	300	(17)	284	58	0	58	226
2045	303	(17)	287	59	0	59	228
2046	307	(17)	290	59	0	59	230
2047	310	(17)	293	60	0	60	232
2048	313	(17)	295	61	0	61	235
2049	316	(18)	298	61	0	61	237
2050	319	(18)	301	62	0	62	239
2051	322	(18)	305	63	0	63	242
2052	326	(18)	308	63	0	63	245
2053	329	(18)	311	64	0	64	247
2054	333	(19)	314	65	0	65	250
2055	336	(19)	317	65	0	65	252
2056	340	(19)	321	66	0	66	255
2057	343	(19)	324	66	0	66	257
2058	346	(19)	327	67	0	67	260
2059	350	(20)	330	68	0	68	263
2060	353	(20)	334	68	0	68	265
2061	357	(20)	337	69	0	69	268
2062	360	(20)	340	70	0	70	270
2063	364	(20)	344	70	0	70	273
2064	367	(21)	347	71	0	71	276
2065	371	(21)	350	72	0	72	278
2066	374	(21)	354	73	0	73	281
2067	378	(21)	357	73	0	73	284
2068	382	(21)	360	74	0	74	286
2069	385	(21)	364	75	0	75	289
2070	389	(22)	367	75	0	75	292

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Dumas's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	162	0	0	0
1	2015	15,001	162	2	208	(13)
2	2016	15,380	161	4	211	(16)
3	2017	15,759	161	7	213	(18)
4	2018	16,139	160	9	215	(21)
5-year Goal	2019	16,518	160	12	218	(24)
6	2020	16,897	160	14	220	(26)
7	2021	17,133	160	15	223	(28)
8	2022	17,370	159	16	225	(29)
9	2023	17,606	159	18	228	(31)
10-year Goal	2024	17,842	159	20	230	(33)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Dumas's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	28.00	0	0	0
1	2015	15,001	27.00	5	(11)	(5)
2	2016	15,380	26.00	11	(11)	0
3	2017	15,759	25.00	17	(12)	6
4	2018	16,139	24.00	24	(12)	12
5-year Goal	2019	16,518	23.00	30	(12)	18
6	2020	16,897	22.00	37	(12)	25
7	2021	17,133	21.00	44	(13)	31
8	2022	17,370	20.00	51	(13)	38
9	2023	17,606	19.00	58	(13)	45
10-year Goal	2024	17,842	18.00	65	(13)	52

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 11 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 100% increase in 2015
    b. Estimated customer demand reduction of 20%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Showerhead Distribution (SF)

a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Showerheads (SF)	TOTAL SAVINGS
2013		0.8	0.8
2014		1.3	1.3
2015	218	1.7	219.2
2016	220	1.9	222.0
2017	223	1.9	224.6
2018	225	1.9	227.3
2019	228	1.9	229.9
2020	231	1.9	232.5
2021	233	1.9	235.1
2022	236	1.9	237.7
2023	238	1.9	240.4
2024	241	1.9	243.0
2025	244	1.9	245.6
2026	246	1.9	248.2
2027	249	1.9	250.8
2028	252	1.9	253.5
2029	254	1.9	256.1
2030	257	1.9	258.8
2031	260	1.9	261.7
2032	263	1.9	264.6
2033	266	1.9	267.5
2034	269	1.9	270.5
2035	271	1.9	273.4
2036	274	1.9	276.3
2037	277	1.9	279.2
2038	280	1.9	282.1
2039	283	1.9	285.1
2040	286	1.9	287.9
2041	289	1.9	291.0
2042	292	1.9	294.1
2043	295	1.9	297.3
2044	298	1.9	300.4
2045	302	1.9	303.5
2046	305	1.9	306.6
2047	308	1.9	309.7
2048	311	1.9	312.8
2049	314	1.9	315.9
2050	317	1.9	319.1
2051	321	1.9	322.5
2052	324	1.9	325.9
2053	327	1.9	329.3
2054	331	1.9	332.8
2055	334	1.9	336.2
2056	338	1.9	339.6
2057	341	1.9	343.0
2058	345	1.9	346.4
2059	348	1.9	349.9
2060	351	1.9	353.3
2061	355	1.9	356.8
2062	358	1.9	360.3
2063	362	1.9	363.9
2064	366	1.9	367.4
2065	369	1.9	370.9
2066	373	1.9	374.5
2067	376	1.9	378.0
2068	380	1.9	381.5
2069	383	1.9	385.1
2070	387	1.9	388.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	14,622	28	0
2015	15,001	30	(11)
2016	15,380	30	(11)
2017	15,759	30	(12)
2018	16,139	30	(12)
2019	16,518	30	(12)
2020	16,897	30	(12)
2021	17,133	30	(13)
2022	17,370	30	(13)
2023	17,606	30	(13)
2024	17,842	30	(13)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	222	(11)	211	15	24	0	24	201
2017	225	(12)	213	15	24	0	24	204
2018	227	(12)	215	15	29	0	29	202
2019	230	(12)	218	15	34	0	34	199
2020	233	(12)	220	15	43	0	43	192
2021	235	(13)	223	16	44	0	44	194
2022	238	(13)	225	16	45	0	45	196
2023	240	(13)	228	16	45	0	45	198
2024	243	(13)	230	16	46	0	46	200
2025	246	(13)	232	16	46	0	46	202
2026	248	(13)	235	17	47	0	47	204
2027	251	(14)	237	17	48	0	48	206
2028	253	(14)	240	17	48	0	48	208
2029	256	(14)	242	17	49	0	49	210
2030	259	(14)	245	17	50	0	50	212
2031	262	(14)	247	17	50	0	50	215
2032	265	(14)	250	18	51	0	51	217
2033	268	(15)	253	18	51	0	51	219
2034	270	(15)	256	18	52	0	52	222
2035	273	(15)	258	18	53	0	53	224
2036	276	(15)	261	18	53	0	53	226
2037	279	(15)	264	19	54	0	54	229
2038	282	(16)	267	19	54	0	54	231
2039	285	(16)	269	19	55	0	55	233
2040	288	(16)	272	19	56	0	56	235

1. Employ efforts to maintain water loss volumes near baseline level or below.
2. In the future, as your utility finds water and/or wastewater service rate increases necessary, such pricing signals should continue to be effective in reducing demand.

Statewide Water Conservation Quantification Project
City of Perryton Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use

[1] Equal to 811,224 acre-feet per year in conservation savings.

- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Perryton's current water conservation activities and their quantified savings to two metrics: 1) Region A Water Plan's (Texas Water Development Board, 2016) recommended WMS supply volumes for municipal conservation, and 2) Perryton's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Perryton's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Perryton with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).[12] Refer to Tables 5-1 and 5-2 for details on these savings.

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If the utility's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	24	(64)	(40)	12	0	12	(53)
2016	24	(65)	(41)	15	0	15	(56)
2017	24	(66)	(41)	15	0	15	(57)
2018	25	(66)	(42)	18	0	18	(60)
2019	25	(67)	(42)	22	0	22	(64)
2020	25	(67)	(43)	28	0	28	(70)
2021	25	(68)	(43)	28	0	28	(71)
2022	25	(68)	(43)	28	0	28	(71)
2023	25	(69)	(44)	28	0	28	(72)
2024	25	(69)	(44)	28	0	28	(72)
2025	26	(70)	(44)	29	0	29	(73)
2026	26	(70)	(45)	29	0	29	(73)
2027	26	(71)	(45)	29	0	29	(74)
2028	26	(71)	(45)	29	0	29	(74)
2029	26	(72)	(46)	29	0	29	(75)
2030	26	(72)	(46)	29	0	29	(75)
2031	27	(73)	(47)	30	0	30	(76)
2032	27	(74)	(47)	30	0	30	(77)
2033	27	(74)	(47)	30	0	30	(77)
2034	27	(75)	(48)	30	0	30	(78)
2035	27	(75)	(48)	30	0	30	(78)
2036	27	(76)	(48)	31	0	31	(79)
2037	28	(76)	(49)	31	0	31	(79)
2038	28	(77)	(49)	31	0	31	(80)
2039	28	(77)	(50)	31	0	31	(81)
2040	28	(78)	(50)	31	0	31	(81)
2041	28	(78)	(50)	32	0	32	(82)
2042	28	(79)	(51)	32	0	32	(82)
2043	29	(80)	(51)	32	0	32	(83)
2044	29	(80)	(51)	32	0	32	(84)
2045	29	(81)	(52)	32	0	32	(84)
2046	29	(81)	(52)	33	0	33	(85)
2047	29	(82)	(53)	33	0	33	(86)
2048	30	(83)	(53)	33	0	33	(86)
2049	30	(83)	(53)	33	0	33	(87)
2050	30	(84)	(54)	34	0	34	(87)
2051	30	(84)	(54)	34	0	34	(88)
2052	30	(85)	(55)	34	0	34	(89)
2053	31	(86)	(55)	34	0	34	(89)
2054	31	(86)	(55)	35	0	35	(90)
2055	31	(87)	(56)	35	0	35	(91)
2056	31	(87)	(56)	35	0	35	(91)
2057	31	(88)	(57)	35	0	35	(92)
2058	32	(89)	(57)	36	0	36	(93)
2059	32	(89)	(57)	36	0	36	(93)
2060	32	(90)	(58)	36	0	36	(94)
2061	32	(91)	(58)	36	0	36	(95)
2062	33	(91)	(59)	37	0	37	(95)
2063	33	(92)	(59)	37	0	37	(96)
2064	33	(93)	(60)	37	0	37	(97)
2065	33	(93)	(60)	37	0	37	(97)
2066	34	(94)	(60)	38	0	38	(98)
2067	34	(95)	(61)	38	0	38	(99)
2068	34	(95)	(61)	38	0	38	(100)
2069	34	(96)	(62)	39	0	39	(100)
2070	35	(97)	(62)	39	0	39	(101)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Perryton's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	215	0	0	0
1	2015	9,300	214	3	(40)	(44)
2	2016	9,386	213	7	(41)	(48)
3	2017	9,471	212	10	(41)	(52)
4	2018	9,557	211	14	(42)	(56)
5-year Goal	2019	9,642	210	18	(42)	(60)
6	2020	9,728	209	21	(43)	(64)
7	2021	9,801	208	25	(43)	(68)
8	2022	9,873	207	29	(43)	(72)
9	2023	9,946	206	33	(44)	(76)
10-year Goal	2024	10,018	205	37	(44)	(81)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Perryton's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	23.00	0	0	0
1	2015	9,300	22.40	2	(64)	(67)
2	2016	9,386	21.80	4	(65)	(69)
3	2017	9,471	21.20	6	(66)	(72)
4	2018	9,557	20.60	8	(66)	(75)
5-year Goal	2019	9,642	20.00	11	(67)	(77)
6	2020	9,728	19.40	13	(67)	(80)
7	2021	9,801	18.80	15	(68)	(83)
8	2022	9,873	18.20	17	(68)	(86)
9	2023	9,946	17.60	20	(69)	(89)
10-year Goal	2024	10,018	17.00	22	(69)	(91)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 64 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 13.5% increase in 2015
    b. Estimated customer demand reduction of 2.7%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012	0	0
2013	0	0
2014	0	0
2015	24.2	24.2
2016	24.3	24.3
2017	24.5	24.5
2018	24.6	24.6
2019	24.7	24.7
2020	24.9	24.9
2021	25.0	25.0
2022	25.2	25.2
2023	25.3	25.3
2024	25.5	25.5
2025	25.6	25.6
2026	25.8	25.8
2027	25.9	25.9
2028	26.1	26.1
2029	26.2	26.2
2030	26.3	26.3
2031	26.5	26.5
2032	26.7	26.7
2033	26.8	26.8
2034	27.0	27.0
2035	27.2	27.2
2036	27.3	27.3
2037	27.5	27.5
2038	27.7	27.7
2039	27.8	27.8
2040	28.0	28.0
2041	28.2	28.2
2042	28.4	28.4
2043	28.6	28.6
2044	28.8	28.8
2045	29.0	29.0
2046	29.2	29.2
2047	29.4	29.4
2048	29.5	29.5
2049	29.7	29.7
2050	29.9	29.9
2051	30.1	30.1
2052	30.4	30.4
2053	30.6	30.6
2054	30.8	30.8
2055	31.0	31.0
2056	31.2	31.2
2057	31.5	31.5
2058	31.7	31.7
2059	31.9	31.9
2060	32.1	32.1
2061	32.4	32.4
2062	32.6	32.6
2063	32.8	32.8
2064	33.1	33.1
2065	33.3	33.3
2066	33.6	33.6
2067	33.8	33.8
2068	34.0	34.0
2069	34.3	34.3
2070	34.5	34.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	23.00	0
2015	9,300	42.00	(64)
2016	9,386	42.00	(65)
2017	9,471	42.00	(66)
2018	9,557	42.00	(66)
2019	9,642	42.00	(67)
2020	9,728	42.00	(67)
2021	9,801	42.00	(68)
2022	9,873	42.00	(68)
2023	9,946	42.00	(69)
2024	10,018	42.00	(69)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	24	(65)	(41)	12	15	0	15	(44)
2017	24	(66)	(41)	12	15	0	15	(44)
2018	25	(66)	(42)	12	18	0	18	(48)
2019	25	(67)	(42)	12	22	0	22	(51)
2020	25	(67)	(43)	12	28	0	28	(58)
2021	25	(68)	(43)	12	28	0	28	(58)
2022	25	(68)	(43)	12	28	0	28	(59)
2023	25	(69)	(44)	13	28	0	28	(59)
2024	25	(69)	(44)	13	28	0	28	(60)
2025	26	(70)	(44)	13	29	0	29	(60)
2026	26	(70)	(45)	13	29	0	29	(61)
2027	26	(71)	(45)	13	29	0	29	(61)
2028	26	(71)	(45)	13	29	0	29	(62)
2029	26	(72)	(46)	13	29	0	29	(62)
2030	26	(72)	(46)	13	29	0	29	(62)
2031	27	(73)	(47)	13	30	0	30	(63)
2032	27	(74)	(47)	13	30	0	30	(63)
2033	27	(74)	(47)	13	30	0	30	(64)
2034	27	(75)	(48)	13	30	0	30	(64)
2035	27	(75)	(48)	13	30	0	30	(65)
2036	27	(76)	(48)	14	31	0	31	(65)
2037	28	(76)	(49)	14	31	0	31	(66)
2038	28	(77)	(49)	14	31	0	31	(66)
2039	28	(77)	(50)	14	31	0	31	(67)
2040	28	(78)	(50)	14	31	0	31	(67)

Region B Individual Reports

Statewide Water Conservation Quantification Project
City of Wichita Falls Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Wichita Falls' current water conservation activities and their quantified savings to two metrics: 1) Region B Water Plan's (Texas Water Development Board, 2016a) recommended WMS supply volumes for municipal conservation, and 2) Wichita Falls' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Wichita Falls' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Wichita Falls with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,072	624	1,696	649	0	649	1,047
2016	1,073	625	1,698	812	0	812	886
2017	1,143	626	1,769	812	0	812	957
2018	1,143	628	1,771	974	0	974	797
2019	1,144	629	1,773	1,137	0	1,137	636
2020	1,145	630	1,775	1,461	0	1,461	313
2021	1,146	632	1,778	1,461	0	1,461	316
2022	1,146	634	1,781	1,461	0	1,461	319
2023	1,147	637	1,784	1,461	0	1,461	323
2024	1,148	639	1,787	1,461	0	1,461	326
2025	1,149	641	1,790	1,461	0	1,461	329
2026	1,150	644	1,793	1,461	0	1,461	332
2027	1,150	646	1,796	1,461	0	1,461	335
2028	1,151	648	1,799	1,461	0	1,461	338
2029	1,152	650	1,802	1,461	0	1,461	341
2030	1,153	653	1,805	1,461	0	1,461	344
2031	1,153	655	1,808	1,461	0	1,461	346
2032	1,154	656	1,810	1,461	0	1,461	349
2033	1,154	658	1,812	1,461	0	1,461	351
2034	1,154	660	1,814	1,461	0	1,461	353
2035	1,155	662	1,817	1,461	0	1,461	355
2036	1,155	664	1,819	1,461	0	1,461	358
2037	1,156	665	1,821	1,461	0	1,461	360
2038	1,156	667	1,823	1,461	0	1,461	362
2039	1,157	669	1,826	1,461	0	1,461	364
2040	1,157	671	1,828	1,461	0	1,461	367
2041	1,158	672	1,830	1,461	0	1,461	369
2042	1,159	673	1,832	1,461	0	1,461	371
2043	1,159	675	1,834	1,461	0	1,461	373
2044	1,160	676	1,836	1,461	0	1,461	375
2045	1,161	677	1,838	1,461	0	1,461	377
2046	1,162	678	1,840	1,461	0	1,461	378
2047	1,162	680	1,842	1,461	0	1,461	380
2048	1,163	681	1,844	1,461	0	1,461	382
2049	1,164	682	1,846	1,461	0	1,461	384
2050	1,164	683	1,848	1,461	0	1,461	386
2051	1,166	685	1,851	1,461	0	1,461	389
2052	1,168	686	1,854	1,461	0	1,461	392
2053	1,170	687	1,857	1,461	0	1,461	395
2054	1,171	688	1,860	1,461	0	1,461	398
2055	1,173	689	1,863	1,461	0	1,461	401
2056	1,175	691	1,866	1,461	0	1,461	404
2057	1,177	692	1,869	1,461	0	1,461	407
2058	1,179	693	1,872	1,461	0	1,461	410
2059	1,180	694	1,875	1,461	0	1,461	413
2060	1,182	695	1,878	1,461	0	1,461	416
2061	1,184	696	1,880	1,461	0	1,461	419
2062	1,186	697	1,883	1,461	0	1,461	422
2063	1,187	699	1,886	1,461	0	1,461	425
2064	1,189	700	1,889	1,461	0	1,461	427
2065	1,191	701	1,891	1,461	0	1,461	430
2066	1,193	702	1,894	1,461	0	1,461	433
2067	1,194	703	1,897	1,461	0	1,461	436
2068	1,196	704	1,900	1,461	0	1,461	438
2069	1,198	705	1,902	1,461	0	1,461	441
2070	1,199	706	1,905	1,461	0	1,461	444

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Wichita Falls' quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	153	0	0	0
1	2015	106,876	155	(94)	1,696	1,790
2	2016	107,068	158	(188)	1,698	1,886
3	2017	107,260	160	(282)	1,769	2,051
4	2018	107,451	163	(377)	1,771	2,147
5-year Goal	2019	107,643	165	(471)	1,773	2,244
6	2020	107,835	164	(433)	1,775	2,208
7	2021	108,228	163	(395)	1,778	2,173
8	2022	108,621	162	(357)	1,781	2,138
9	2023	109,015	161	(318)	1,784	2,102
10-year Goal	2024	109,408	160	(280)	1,787	2,066

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Wichita Falls' most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	106,876	19.20	(47)	624	671
2	2016	107,068	20.40	(94)	625	719
3	2017	107,260	21.60	(141)	626	767
4	2018	107,451	22.80	(188)	628	816
5-year Goal	2019	107,643	24.00	(236)	629	864
6	2020	107,835	24.00	(236)	630	866
7	2021	108,228	24.00	(237)	632	869
8	2022	108,621	24.00	(238)	634	872
9	2023	109,015	24.00	(239)	637	875
10-year Goal	2024	109,408	24.00	(240)	639	879

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for water loss GPCD from the utility's most recently submitted 5-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 624 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 53% increase in 2014
    b. Estimated customer demand reduction of 10.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.42% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

6. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

a. MyH2O: My Water My Way
b. Implemented in 2017
c. Estimated savings of 68.9 MG in 2017
    i. Specific utility results may vary based on portal features and notifications
d. Assumes 20% of residential customers are using and saving water due to the portal (Westin Engineering, 2015)
e. Assumes customers save 10% of total annual use due to the portal
    i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
f. Residential customers' use makes up approximately 61% of all retail customers' use based on utility profile information submitted to the TWDB
g. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.22% of total demand
    i. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	AMI with Customer Portal	Water Rate Increase	TOTAL SAVINGS
2012				0
2013				0
2014			597	597
2015	475		598	1,072
2016	475		598	1,073
2017	475	68.9	598	1,143
2018	476	68.9	599	1,143
2019	476	69.0	599	1,144
2020	476	69.0	600	1,145
2021	477	69.1	600	1,146
2022	477	69.1	600	1,146
2023	477	69.2	601	1,147
2024	478	69.2	601	1,148
2025	478	69.2	602	1,149
2026	478	69.3	602	1,150
2027	479	69.3	602	1,150
2028	479	69.4	603	1,151
2029	479	69.4	603	1,152
2030	480	69.5	604	1,153
2031	480	69.5	604	1,153
2032	480	69.5	604	1,154
2033	480	69.6	604	1,154
2034	480	69.6	605	1,154
2035	480	69.6	605	1,155
2036	481	69.6	605	1,155
2037	481	69.7	605	1,156
2038	481	69.7	606	1,156
2039	481	69.7	606	1,157
2040	481	69.8	606	1,157
2041	482	69.8	606	1,158
2042	482	69.8	607	1,159
2043	482	69.9	607	1,159
2044	483	69.9	608	1,160
2045	483	70.0	608	1,161
2046	483	70.0	608	1,162
2047	483	70.1	609	1,162
2048	484	70.1	609	1,163
2049	484	70.1	609	1,164
2050	484	70.2	610	1,164
2051	485	70.3	611	1,166
2052	486	70.4	612	1,168
2053	487	70.5	613	1,170
2054	487	70.6	614	1,171
2055	488	70.7	614	1,173
2056	489	70.8	615	1,175
2057	490	70.9	616	1,177
2058	490	71.0	617	1,179
2059	491	71.2	618	1,180
2060	492	71.3	619	1,182
2061	493	71.4	620	1,184
2062	493	71.5	621	1,186
2063	494	71.6	622	1,187
2064	495	71.7	623	1,189
2065	495	71.8	624	1,191
2066	496	71.9	625	1,193
2067	497	72.0	625	1,194
2068	498	72.1	626	1,196
2069	498	72.2	627	1,198
2070	499	72.3	628	1,199

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	18.00	0
2015	106,876	2.00	624
2016	107,068	2.00	625
2017	107,260	2.00	626
2018	107,451	2.00	628
2019	107,643	2.00	629
2020	107,835	2.00	630
2021	108,228	2.00	632
2022	108,621	2.00	634
2023	109,015	2.00	637
2024	109,408	2.00	639

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Rain Barrels
    - **a.** In Region B, utilities could save approximately 16.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    - **b.** Estimated 10-year useful life for most barrels

Region C Individual Reports

Statewide Water Conservation Quantification Project
City of Addison Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Addison's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Addison's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Addison's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Addison with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	23.1	6	29	12	4	16	13
2016	41.7	6	47	14	5	20	27
2017	42.5	5	48	14	7	21	27
2018	43.3	5	49	17	8	25	24
2019	44.2	5	50	20	9	29	21
2020	45.0	5	50	26	10	36	14
2021	45.8	5	51	28	10	38	13
2022	46.7	6	52	31	10	41	12
2023	47.5	6	53	33	10	43	10
2024	48.3	6	54	36	10	45	9
2025	49.2	6	55	38	10	48	7
2026	50.0	6	56	41	10	50	6
2027	50.8	6	57	43	10	53	4
2028	51.7	6	58	45	10	55	3
2029	52.5	6	59	48	10	58	1
2030	53.3	6	60	50	10	60	(0)
2031	54.2	6	61	53	9	62	(1)
2032	55.0	7	62	56	8	64	(2)
2033	55.8	7	63	59	7	66	(4)
2034	56.7	7	63	62	6	68	(5)
2035	57.5	7	64	65	5	70	(6)
2036	58.4	7	65	68	4	72	(7)
2037	59.2	7	66	71	3	74	(8)
2038	60.0	7	67	74	2	76	(9)
2039	60.9	7	68	77	1	78	(10)
2040	61.7	7	69	80	0	80	(11)
2041	62.6	8	70	83	0	83	(13)
2042	63.4	8	71	85	0	85	(14)
2043	64.3	8	72	87	0	87	(15)
2044	65.1	8	73	89	0	89	(16)
2045	66.0	8	74	91	0	91	(17)
2046	66.9	8	75	93	0	93	(18)
2047	67.7	8	76	96	0	96	(20)
2048	68.6	8	77	98	0	98	(21)
2049	69.4	8	78	100	0	100	(22)
2050	70.3	8	79	102	0	102	(23)
2051	71.1	9	80	104	0	104	(25)
2052	72.0	9	81	107	0	107	(26)
2053	72.9	9	82	109	0	109	(28)
2054	73.8	9	83	112	0	112	(29)
2055	74.6	9	84	114	0	114	(30)
2056	75.5	9	85	116	0	116	(32)
2057	76.4	9	86	119	0	119	(33)
2058	77.2	9	87	121	0	121	(35)
2059	78.1	9	88	124	0	124	(36)
2060	79.0	10	89	126	0	126	(38)
2061	79.8	10	89	129	0	129	(39)
2062	80.7	10	90	131	0	131	(41)
2063	81.6	10	91	134	0	134	(43)
2064	82.5	10	92	137	0	137	(44)
2065	83.3	10	93	139	0	139	(46)
2066	84.2	10	94	142	0	142	(48)
2067	85.1	10	95	145	0	145	(49)
2068	86.0	10	96	147	0	147	(51)
2069	86.8	10	97	150	0	150	(53)
2070	87.7	11	98	153	0	153	(54)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Addison's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	208	0	0	0
1	2015	15,407	206	13	29	15
2	2016	15,233	203	27	47	21
3	2017	15,060	201	40	48	8
4	2018	14,886	198	52	49	(3)
5-year Goal	2019	14,713	196	64	50	(15)
6	2020	14,539	196	65	50	(14)
7	2021	14,828	196	67	51	(16)
8	2022	15,117	195	70	52	(17)
9	2023	15,407	195	72	53	(19)
10-year Goal	2024	15,696	195	74	54	(20)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Addison's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2015	15,407	13.80	1	6	4
2	2016	15,233	13.60	2	6	3
3	2017	15,060	13.40	3	5	2
4	2018	14,886	13.20	4	5	1
5-year Goal	2019	14,713	13.00	5	5	0
6	2020	14,539	13.00	5	5	0
7	2021	14,828	13.00	5	5	0
8	2022	15,117	13.00	6	6	0
9	2023	15,407	13.00	6	6	0
10-year Goal	2024	15,696	13.00	6	6	0

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 13 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[17]
      i. 6.4% increase in 2015
      ii. 4.9% increase in 2016
   b. Estimated customer demand reduction of 2.26%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
      i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	23	23.1
2016	42	41.7
2017	42	42.5
2018	43	43.3
2019	44	44.2
2020	45	45.0
2021	46	45.8
2022	47	46.7
2023	47	47.5
2024	48	48.3
2025	49	49.2
2026	50	50.0
2027	51	50.8
2028	52	51.7
2029	52	52.5
2030	53	53.3
2031	54	54.2
2032	55	55.0
2033	56	55.8
2034	57	56.7
2035	58	57.5
2036	58	58.4
2037	59	59.2
2038	60	60.0
2039	61	60.9
2040	62	61.7
2041	63	62.6
2042	63	63.4
2043	64	64.3
2044	65	65.1
2045	66	66.0
2046	67	66.9
2047	68	67.7
2048	69	68.6
2049	69	69.4
2050	70	70.3
2051	71	71.1
2052	72	72.0
2053	73	72.9
2054	74	73.8
2055	75	74.6
2056	75	75.5
2057	76	76.4
2058	77	77.2
2059	78	78.1
2060	79	79.0
2061	80	79.8
2062	81	80.7
2063	82	81.6
2064	82	82.5
2065	83	83.3
2066	84	84.2
2067	85	85.1
2068	86	86.0
2069	87	86.8
2070	88	87.7

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.00	0
2015	15,407	13.00	6
2016	15,233	13.00	6
2017	15,060	13.00	5
2018	14,886	13.00	5
2019	14,713	13.00	5
2020	14,539	13.00	5
2021	14,828	13.00	5
2022	15,117	13.00	6
2023	15,407	13.00	6
2024	15,696	13.00	6

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 145 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	42	6	47	145	14	5	20	172
2017	42	5	48	148	14	7	21	175
2018	43	5	49	151	17	8	25	174
2019	44	5	50	154	20	9	29	174
2020	45	5	50	156	26	10	36	171
2021	46	5	51	159	28	10	38	172
2022	47	6	52	162	31	10	41	174
2023	47	6	53	165	33	10	43	175
2024	48	6	54	168	36	10	45	177
2025	49	6	55	171	38	10	48	178
2026	50	6	56	174	41	10	50	179
2027	51	6	57	177	43	10	53	181
2028	52	6	58	180	45	10	55	182
2029	52	6	59	183	48	10	58	184
2030	53	6	60	185	50	10	60	185
2031	54	6	61	188	53	9	62	187
2032	55	7	62	191	56	8	64	189
2033	56	7	63	194	59	7	66	191
2034	57	7	63	197	62	6	68	192
2035	58	7	64	200	65	5	70	194
2036	58	7	65	203	68	4	72	196
2037	59	7	66	206	71	3	74	198
2038	60	7	67	209	74	2	76	200
2039	61	7	68	212	77	1	78	202
2040	62	7	69	215	80	0	80	203

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	42	6	47	24	14	5	20	52
2017	42	5	48	25	14	7	21	52
2018	43	5	49	25	17	8	25	49
2019	44	5	50	26	20	9	29	46
2020	45	5	50	26	26	10	36	41
2021	46	5	51	27	28	10	38	40
2022	47	6	52	27	31	10	41	39
2023	47	6	53	28	33	10	43	38
2024	48	6	54	28	36	10	45	37
2025	49	6	55	29	38	10	48	36
2026	50	6	56	29	41	10	50	35
2027	51	6	57	30	43	10	53	34
2028	52	6	58	30	45	10	55	33
2029	52	6	59	31	48	10	58	32
2030	53	6	60	31	50	10	60	31
2031	54	6	61	32	53	9	62	30
2032	55	7	62	32	56	8	64	30
2033	56	7	63	33	59	7	66	29
2034	57	7	63	33	62	6	68	28
2035	58	7	64	34	65	5	70	28
2036	58	7	65	34	68	4	72	27
2037	59	7	66	34	71	3	74	26
2038	60	7	67	35	74	2	76	26
2039	61	7	68	35	77	1	78	25
2040	62	7	69	36	80	0	80	25

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Allen Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Allen's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Allen's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Allen's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8,9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Allen with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	827	171	998	96	15	111	887
2016	832	173	1,005	119	19	138	867
2017	836	175	1,011	119	22	142	869
2018	840	178	1,018	143	26	170	848
2019	844	180	1,024	167	30	197	827
2020	847	183	1,030	215	34	249	781
2021	852	183	1,035	221	34	255	780
2022	856	184	1,040	228	34	261	779
2023	860	185	1,045	234	34	267	778
2024	864	186	1,050	240	34	274	777
2025	868	187	1,055	246	34	280	776
2026	873	188	1,061	252	34	286	774
2027	877	189	1,066	259	34	292	773
2028	881	190	1,071	265	34	298	772
2029	885	191	1,076	271	34	305	771
2030	889	192	1,081	277	34	311	770
2031	894	193	1,086	282	30	312	774
2032	898	193	1,091	287	27	314	777
2033	902	194	1,096	292	23	316	781
2034	906	195	1,102	297	20	317	784
2035	910	196	1,107	302	17	319	788
2036	915	197	1,112	307	13	320	792
2037	919	198	1,117	312	10	322	795
2038	923	199	1,122	317	7	323	799
2039	927	200	1,127	322	3	325	802
2040	932	201	1,132	327	0	327	806
2041	936	202	1,137	328	0	328	809
2042	940	203	1,143	330	0	330	813
2043	944	203	1,148	331	0	331	817
2044	948	204	1,153	333	0	333	820
2045	953	205	1,158	334	0	334	824
2046	957	206	1,163	336	0	336	828
2047	961	207	1,168	337	0	337	831
2048	965	208	1,173	339	0	339	835
2049	970	209	1,178	340	0	340	838
2050	974	210	1,184	342	0	342	842
2051	978	211	1,189	344	0	344	845
2052	982	212	1,194	346	0	346	848
2053	986	213	1,199	348	0	348	851
2054	991	214	1,204	350	0	350	854
2055	995	214	1,209	352	0	352	857
2056	999	215	1,214	354	0	354	860
2057	1,003	216	1,220	356	0	356	863
2058	1,007	217	1,225	358	0	358	866
2059	1,012	218	1,230	361	0	361	869
2060	1,016	219	1,235	363	0	363	872
2061	1,020	220	1,240	365	0	365	875
2062	1,024	221	1,245	367	0	367	878
2063	1,029	222	1,250	369	0	369	881
2064	1,033	223	1,255	371	0	371	884
2065	1,037	224	1,261	374	0	374	887
2066	1,041	224	1,266	376	0	376	890
2067	1,045	225	1,271	378	0	378	893
2068	1,050	226	1,276	380	0	380	896
2069	1,054	227	1,281	382	0	382	899
2070	1,058	228	1,286	385	0	385	902

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Allen's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	165	0	0	0
1	2015	93,568	164	34	998	964
2	2016	94,854	163	69	1,005	936
3	2017	96,141	162	105	1,011	906
4	2018	97,427	161	142	1,018	875
5-year Goal	2019	98,714	160	180	1,024	844
6	2020	100,000	158	241	1,030	789
7	2021	100,500	157	301	1,035	734
8	2022	101,000	155	361	1,040	679
9	2023	101,500	154	422	1,045	623
10-year Goal	2024	102,000	152	484	1,050	566

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Allen's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	93,568	16.80	7	171	164
2	2016	94,854	16.60	14	173	159
3	2017	96,141	16.40	21	175	154
4	2018	97,427	16.20	28	178	149
5-year Goal	2019	98,714	16.00	36	180	144
6	2020	100,000	15.80	44	183	139
7	2021	100,500	15.60	51	183	132
8	2022	101,000	15.40	59	184	125
9	2023	101,500	15.20	67	185	119
10-year Goal	2024	102,000	15.00	74	186	112

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Robust Public Education Effort**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, school visits, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 171 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.8% increase in 2014
        ii. 5.8% increase in 2015
    b. Estimated customer demand reduction of 2.3%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.84% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

6. **Outdoor Landscape Evaluations (SF)**

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

a. 160 outdoor evaluations performed since 2015
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. Rainwater Barrels

a. In Region C, estimated savings of 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
b. Estimated 10-year useful life for most barrels

8. High Efficiency (HE) Toilet Replacement Program (SF)

a. Quantified program efforts back to 2004
b. Used savings estimate for replacing 3.5 gallons per flush (gpf) toilet with 1.6 gpf toilet for years 2004 – 2013
c. Used savings estimate for replacing 3.5 gallons per flush (gpf) toilet with 1.28 gpf toilet for years 2014 – 2015
d. Replacements per year provided by staff
e. Estimated savings of 8,440 gallons per year per toilet for replacement with 1.6 gpf toilet model (A&N Technical Services, 2005)
f. Estimated savings of 10,390 gallons per year per toilet for replacement with 1.28 gpf toilet (A&N Technical Services, 2005)
g. Savings carry on indefinitely because replacement toilet will be as efficient

9. Clotheswasher Replacement Program (SF)

a. 4,118 rebates issued from 2004 – 2015
b. Rebates per year provided by staff
c. Estimated 7,030 gallons per year per washer (A&N Technical Services, 2005; THELMA, 1997)
d. 11-year useful life

10. Audits by Ordinance (MF, ICI, and HOA)

a. Staff estimated 19% reduction when audits performed
b. Demand for ICI customer class was 783 MG in 2012
c. Average commercial customer use 0.48 MG (783 MG/1,617 customers)
d. 19% reduction per customer = 0.0912 MG savings per customer audit
e. 0.912 MG x 350 audits per year = 33.9 MG of savings annually
f. Increases over time with continuing population and ICI connection rate increases

11. Custom Rebates

i. Not quantified — Did not have sufficient information on devices that were rebated.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Rain Barrels	Outdoor Landscape Evaluations	HE Toilet Rebates (SF)	HE Clothes Washer Rebates (SF)	Water Rate Increases	Audits by Ordinance (ICI)	Custom Rebates*	TOTAL SAVINGS
2009		0.18		9.9	17.6		34		62
2010		0.26		11.6	20.4		34		66
2011		0.33		12.8	22.4		34		70
2012		0.36		15.5	24.4		35		75
2013		0.42		19.5	26.5		35		81
2014		0.44		26.3	27.9	78	35		168
2015	578	0.47	0.64	33.1	28.9	151	35		827
2016	582	0.45	1.16	33.1	28.9	151	35		832
2017	585	0.43	0.92	33.1	28.9	152	35		836
2018	588	0.36	0.68	33.1	28.9	153	36		840
2019	591	0.30	0.44	33.1	28.9	154	36		844
2020	594	0.22		33.1	28.9	155	36		847
2021	598	0.15		33.1	28.9	156	36		852
2022	601	0.11		33.1	28.9	156	36		856
2023	604	0.05		33.1	28.9	157	37		860
2024	607	0.03		33.1	28.9	158	37		864
2025	610			33.1	28.9	159	37		868
2026	614			33.1	28.9	160	37		873
2027	617			33.1	28.9	160	37		877
2028	620			33.1	28.9	161	38		881
2029	623			33.1	28.9	162	38		885
2030	626			33.1	28.9	163	38		889
2031	630			33.1	28.9	164	38		894
2032	633			33.1	28.9	165	38		898
2033	636			33.1	28.9	165	38		902
2034	639			33.1	28.9	166	39		906
2035	642			33.1	28.9	167	39		910
2036	646			33.1	28.9	168	39		915
2037	649			33.1	28.9	169	39		919
2038	652			33.1	28.9	170	39		923
2039	655			33.1	28.9	170	40		927
2040	658			33.1	28.9	171	40		932
2041	662			33.1	28.9	172	40		936
2042	665			33.1	28.9	173	40		940
2043	668			33.1	28.9	174	40		944
2044	671			33.1	28.9	175	41		948
2045	674			33.1	28.9	175	41		953
2046	678			33.1	28.9	176	41		957
2047	681			33.1	28.9	177	41		961
2048	684			33.1	28.9	178	41		965
2049	687			33.1	28.9	179	41		970
2050	690			33.1	28.9	180	42		974
2051	694			33.1	28.9	180	42		978
2052	697			33.1	28.9	181	42		982
2053	700			33.1	28.9	182	42		986
2054	703			33.1	28.9	183	42		991
2055	706			33.1	28.9	184	43		995
2056	710			33.1	28.9	185	43		999
2057	713			33.1	28.9	185	43		1,003
2058	716			33.1	28.9	186	43		1,007
2059	719			33.1	28.9	187	43		1,012
2060	722			33.1	28.9	188	44		1,016
2061	726			33.1	28.9	189	44		1,020
2062	729			33.1	28.9	190	44		1,024
2063	732			33.1	28.9	190	44		1,029
2064	735			33.1	28.9	191	44		1,033
2065	738			33.1	28.9	192	44		1,037
2066	742			33.1	28.9	193	45		1,041
2067	745			33.1	28.9	194	45		1,045
2068	748			33.1	28.9	195	45		1,050
2069	751			33.1	28.9	195	45		1,054
2070	754			33.1	28.9	196	45		1,058

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	93,568	12.00	171
2016	94,854	12.00	173
2017	96,141	12.00	175
2018	97,427	12.00	178
2019	98,714	12.00	180
2020	100,000	12.00	183
2021	100,500	12.00	183
2022	101,000	12.00	184
2023	101,500	12.00	185
2024	102,000	12.00	186

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	832	173	1,005	88	119	19	138	955
2017	836	175	1,011	89	119	22	142	958
2018	840	178	1,018	89	143	26	170	937
2019	844	180	1,024	90	167	30	197	916
2020	847	183	1,030	90	215	34	249	871
2021	852	183	1,035	91	221	34	255	871
2022	856	184	1,040	91	228	34	261	870
2023	860	185	1,045	92	234	34	267	869
2024	864	186	1,050	92	240	34	274	869
2025	868	187	1,055	93	246	34	280	868
2026	873	188	1,061	93	252	34	286	868
2027	877	189	1,066	94	259	34	292	867
2028	881	190	1,071	94	265	34	298	866
2029	885	191	1,076	94	271	34	305	866
2030	889	192	1,081	95	277	34	311	865
2031	894	193	1,086	95	282	30	312	869
2032	898	193	1,091	96	287	27	314	873
2033	902	194	1,096	96	292	23	316	877
2034	906	195	1,102	97	297	20	317	881
2035	910	196	1,107	97	302	17	319	885
2036	915	197	1,112	98	307	13	320	889
2037	919	198	1,117	98	312	10	322	893
2038	923	199	1,122	99	317	7	323	897
2039	927	200	1,127	99	322	3	325	902
2040	932	201	1,132	100	327	0	327	906

Statewide Water Conservation Quantification Project
City of Arlington Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Arlington's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Arlington's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Arlington's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Arlington with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with

---

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	497	135	632	137	49	186	446
2016	724	136	860	172	61	232	628
2017	1,014	138	1,152	172	73	245	907
2018	1,017	139	1,156	206	85	291	864
2019	1,019	140	1,160	241	97	338	822
2020	1,023	142	1,164	309	109	418	746
2021	1,026	142	1,168	331	109	441	728
2022	1,030	143	1,173	353	109	463	710
2023	1,033	144	1,178	376	109	485	693
2024	1,037	145	1,182	398	109	507	675
2025	1,041	146	1,187	420	109	529	658
2026	1,045	147	1,192	442	109	551	640
2027	1,048	148	1,196	464	109	573	623
2028	1,052	149	1,201	486	109	595	606
2029	1,056	150	1,205	508	109	617	588
2030	1,059	151	1,210	530	109	639	571
2031	1,060	151	1,211	549	98	648	563
2032	1,060	151	1,211	569	87	656	556
2033	1,061	152	1,212	588	76	664	548
2034	1,061	152	1,213	607	66	673	540
2035	1,061	152	1,214	626	55	681	533
2036	1,062	153	1,214	645	44	689	525
2037	1,062	153	1,215	665	33	697	518
2038	1,063	153	1,216	684	22	706	510
2039	1,063	154	1,217	703	11	714	503
2040	1,064	154	1,218	722	0	722	495
2041	1,064	154	1,218	726	0	726	492
2042	1,064	154	1,218	730	0	730	488
2043	1,064	154	1,218	734	0	734	485
2044	1,064	155	1,219	737	0	737	481
2045	1,064	155	1,219	741	0	741	478
2046	1,064	155	1,219	745	0	745	474
2047	1,065	155	1,220	749	0	749	471
2048	1,065	155	1,220	752	0	752	468
2049	1,065	155	1,220	756	0	756	464
2050	1,065	156	1,221	760	0	760	461
2051	1,065	156	1,221	768	0	768	453
2052	1,065	156	1,221	776	0	776	446
2053	1,066	156	1,221	783	0	783	438
2054	1,066	156	1,222	791	0	791	431
2055	1,066	156	1,222	799	0	799	423
2056	1,066	156	1,222	807	0	807	416
2057	1,067	156	1,223	814	0	814	408
2058	1,067	156	1,223	822	0	822	401
2059	1,067	156	1,223	830	0	830	393
2060	1,067	156	1,223	838	0	838	386
2061	1,067	156	1,224	845	0	845	378
2062	1,067	156	1,224	853	0	853	371
2063	1,067	156	1,224	861	0	861	363
2064	1,067	156	1,224	868	0	868	355
2065	1,067	156	1,224	876	0	876	348
2066	1,068	156	1,224	884	0	884	340
2067	1,068	156	1,224	891	0	891	333
2068	1,068	156	1,224	899	0	899	325
2069	1,068	156	1,224	907	0	907	317
2070	1,068	156	1,224	914	0	914	310

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Arlington's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	159	0	0	0
1	2015	370,367	157	216	632	416
2	2016	373,839	156	437	860	424
3	2017	377,310	154	661	1,152	491
4	2018	380,782	153	890	1,156	266
5-year Goal	2019	384,253	151	1,122	1,160	38
6	2020	387,725	149	1,359	1,164	(194)
7	2021	390,227	148	1,595	1,168	(427)
8	2022	392,729	146	1,835	1,173	(662)
9	2023	395,231	145	2,077	1,178	(900)
10-year Goal	2024	397,733	143	2,323	1,182	(1,140)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Arlington's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	370,367	15.80	27	135	108
2	2016	373,839	15.60	55	136	82
3	2017	377,310	15.40	83	138	55
4	2018	380,782	15.20	111	139	28
5-year Goal	2019	384,253	15.00	140	140	0
6	2020	387,725	14.80	170	142	(28)
7	2021	390,227	14.60	199	142	(57)
8	2022	392,729	14.40	229	143	(86)
9	2023	395,231	14.20	260	144	(115)
10-year Goal	2024	397,733	14.00	290	145	(145)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 135 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10.1% increase in 2015
        ii. 4.3% increase in 2016
    b. Estimated customer demand reduction of 3.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years

5. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**
    a. Texas A&M AgriLife Research Extension and Texas Water Resources Institute web-based customer portal
    b. Pilot implemented in 2014
    c. Estimated savings of 289 MG in 2017

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

d. Assumes a full 20% of residential customers are now using and saving water due to the portal after continued implementation from 2014 – 2016
e. Assumes customers save 10% of total annual use due to the portal
    i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
    ii. Texas Water Resources Institute reported a 12.85% reduction over one year, however, savings reduction decreased the following winter (Texas A&M and Texas Water Resources Institute, 2016).
f. Residential customers' use makes up approximately 72% of all retail customers' use based on utility profile information submitted to the TWDB
g. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.43% of total demand
h. Savings are assumed to increase along with demand as connections increase each year[19]

6. Outdoor Landscape Evaluations (SF) — W.I.S.E. Guys Program
a. 500 outdoor evaluations performed since 2012
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
b. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. WaterWise Take-home Kits
a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
b. Conservative 5-year useful life for all items in kit
c. 15% adoption rate assumed

8. Save Water Co. Commercial, Multi-family and Hotel Programs[20]
a. Project initiated in service area in 2015
b. Save Water completed work on 303 multi-family units in 2016
c. Average monthly savings of 913,742 gallons
d. Annualized savings of 11 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.
[20] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

9. High Efficiency (HE) Toilet Replacement Program (SF)

a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
b. Number of toilets replaced per year provided by utility staff
c. Savings carry on indefinitely because replacement toilet will be as efficient

10. Showerhead Distribution (SF)

a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
b. Number of showerheads replaced per year provided by utility staff
c. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	W.I.S.E. Guys Audits	WaterWise Take-home Kits	HE Toilet Rebates (SF)	Low Flow Showerheads (SF)	Water Rate Increases	AMI with Customer Portal	Save Water Co. Program	TOTAL SAVINGS
2009			6.2	1.8				8
2010			12.5	3.7				16
2011			18.7	5.5				24
2012	0.8	0.6	24.9	7.4				34
2013	1.4	1.0	31.2	9.2				43
2014	1.9	1.3	37.4	11.1				52
2015	2.2	1.6	43.6	12.9	428		9	497
2016	2.4	1.7	49.9	14.8	644		11	724
2017	1.6	1.1	49.9	14.8	647	289	11	1,014
2018	1.0	0.7	49.9	14.8	649	290	11	1,017
2019	0.5	0.3	49.9	14.8	652	291	11	1,019
2020	0.2	0.1	49.9	14.8	654	292	11	1,023
2021			49.9	14.8	657	293	11	1,026
2022			49.9	14.8	660	295	11	1,030
2023			49.9	14.8	662	296	11	1,033
2024			49.9	14.8	665	297	11	1,037
2025			49.9	14.8	667	298	11	1,041
2026			49.9	14.8	670	299	11	1,045
2027			49.9	14.8	672	300	11	1,048
2028			49.9	14.8	675	301	11	1,052
2029			49.9	14.8	677	303	11	1,056
2030			49.9	14.8	680	304	11	1,059
2031			49.9	14.8	680	304	11	1,060
2032			49.9	14.8	681	304	11	1,060
2033			49.9	14.8	681	304	11	1,061
2034			49.9	14.8	681	304	11	1,061
2035			49.9	14.8	681	304	11	1,061
2036			49.9	14.8	682	305	11	1,062
2037			49.9	14.8	682	305	11	1,062
2038			49.9	14.8	682	305	11	1,063
2039			49.9	14.8	683	305	11	1,063
2040			49.9	14.8	683	305	11	1,064
2041			49.9	14.8	683	305	11	1,064
2042			49.9	14.8	683	305	11	1,064
2043			49.9	14.8	683	305	11	1,064
2044			49.9	14.8	683	305	11	1,064
2045			49.9	14.8	683	305	11	1,064
2046			49.9	14.8	684	305	11	1,064
2047			49.9	14.8	684	305	11	1,065
2048			49.9	14.8	684	305	11	1,065
2049			49.9	14.8	684	305	11	1,065
2050			49.9	14.8	684	305	11	1,065
2051			49.9	14.8	684	306	11	1,065
2052			49.9	14.8	684	306	11	1,065
2053			49.9	14.8	684	306	11	1,066
2054			49.9	14.8	685	306	11	1,066
2055			49.9	14.8	685	306	11	1,066
2056			49.9	14.8	685	306	11	1,066
2057			49.9	14.8	685	306	11	1,067
2058			49.9	14.8	685	306	11	1,067
2059			49.9	14.8	685	306	11	1,067
2060			49.9	14.8	685	306	11	1,067
2061			49.9	14.8	685	306	11	1,067
2062			49.9	14.8	686	306	11	1,067
2063			49.9	14.8	686	306	11	1,067
2064			49.9	14.8	686	306	11	1,067
2065			49.9	14.8	686	306	11	1,067
2066			49.9	14.8	686	306	11	1,068
2067			49.9	14.8	686	306	11	1,068
2068			49.9	14.8	686	306	11	1,068
2069			49.9	14.8	686	306	11	1,068
2070			49.9	14.8	686	306	11	1,068

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	370,367	15.00	135
2016	373,839	15.00	136
2017	377,310	15.00	138
2018	380,782	15.00	139
2019	384,253	15.00	140
2020	387,725	15.00	142
2021	390,227	15.00	142
2022	392,729	15.00	143
2023	395,231	15.00	144
2024	397,733	15.00	145

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  - **a.** Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
  - **b.** Savings could be 1,628 MG per year with current demand.
  - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	724	136	860	1,628	172	61	232	2,256
2017	1,014	138	1,152	1,634	172	73	245	2,541
2018	1,017	139	1,156	1,641	206	85	291	2,505
2019	1,019	140	1,160	1,647	241	97	338	2,469
2020	1,023	142	1,164	1,654	309	109	418	2,399
2021	1,026	142	1,168	1,660	331	109	441	2,388
2022	1,030	143	1,173	1,666	353	109	463	2,377
2023	1,033	144	1,178	1,673	376	109	485	2,366
2024	1,037	145	1,182	1,679	398	109	507	2,355
2025	1,041	146	1,187	1,686	420	109	529	2,344
2026	1,045	147	1,192	1,692	442	109	551	2,333
2027	1,048	148	1,196	1,699	464	109	573	2,322
2028	1,052	149	1,201	1,705	486	109	595	2,311
2029	1,056	150	1,205	1,712	508	109	617	2,300
2030	1,059	151	1,210	1,718	530	109	639	2,289
2031	1,060	151	1,211	1,719	549	98	648	2,282
2032	1,060	151	1,211	1,720	569	87	656	2,275
2033	1,061	152	1,212	1,720	588	76	664	2,268
2034	1,061	152	1,213	1,721	607	66	673	2,262
2035	1,061	152	1,214	1,722	626	55	681	2,255
2036	1,062	153	1,214	1,723	645	44	689	2,248
2037	1,062	153	1,215	1,723	665	33	697	2,241
2038	1,063	153	1,216	1,724	684	22	706	2,234
2039	1,063	154	1,217	1,725	703	11	714	2,228
2040	1,064	154	1,218	1,726	722	0	722	2,221

2. Rain Barrels
  - **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
  - **b.** Estimated 10-year useful life for most barrels

TWDB Statewide Water Conservation Quantification Project
City of Balch Springs Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, we first engaged with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

We then quantified each utility's conservation activities through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Balch Springs' current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Balch Springs' own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Balch Springs' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. We are not aware of all activities that are ongoing. Some activities within a utility's service area are implemented on a micro-scale that we cannot yet quantify. Individual households and businesses may be implementing conservation measures that we do not know about and therefore cannot include in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures we have carried forward in our model because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. Our approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Balch Springs with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

---

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. Because the regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, we have quantified utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	21.8	(9)	13	1	2	3	10
2016	21.9	(9)	13	2	3	4	9
2017	22.1	(9)	13	2	3	5	8
2018	22.2	(9)	13	2	4	6	7
2019	22.3	(9)	13	2	4	6	6
2020	22.4	(10)	13	3	5	7	5
2021	22.5	(10)	13	3	5	8	5
2022	22.6	(10)	13	4	5	8	5
2023	22.8	(10)	13	4	5	8	4
2024	22.9	(10)	13	4	5	9	4
2025	23.0	(10)	13	5	5	9	4
2026	23.1	(10)	13	5	5	9	3
2027	23.2	(10)	13	5	5	10	3
2028	23.4	(10)	13	6	5	10	3
2029	23.5	(10)	13	6	5	10	3
2030	23.6	(11)	13	6	5	11	2
2031	23.7	(11)	13	7	4	11	2
2032	23.9	(11)	13	7	4	11	2
2033	24.0	(11)	13	7	3	11	3
2034	24.1	(11)	13	8	3	10	3
2035	24.3	(11)	13	8	2	10	3
2036	24.4	(11)	13	9	2	10	3
2037	24.6	(11)	13	9	1	10	3
2038	24.7	(11)	13	9	1	10	3
2039	24.8	(11)	13	10	0	10	3
2040	25.0	(12)	13	10	0	10	3
2041	25.2	(12)	14	11	0	11	3
2042	25.4	(12)	14	11	0	11	3
2043	25.5	(12)	14	11	0	11	2
2044	25.7	(12)	14	12	0	12	2
2045	25.9	(12)	14	12	0	12	2
2046	26.1	(12)	14	13	0	13	1
2047	26.3	(12)	14	13	0	13	1
2048	26.5	(12)	14	13	0	13	1
2049	26.7	(12)	14	14	0	14	0
2050	26.8	(13)	14	14	0	14	(0)
2051	27.0	(13)	14	15	0	15	(0)
2052	27.3	(13)	14	15	0	15	(1)
2053	27.5	(13)	15	16	0	16	(1)
2054	27.7	(13)	15	16	0	16	(2)
2055	27.9	(13)	15	17	0	17	(2)
2056	28.1	(13)	15	17	0	17	(2)
2057	28.3	(13)	15	18	0	18	(3)
2058	28.5	(13)	15	18	0	18	(3)
2059	28.7	(13)	15	19	0	19	(4)
2060	28.9	(14)	15	19	0	19	(4)
2061	29.1	(14)	15	20	0	20	(4)
2062	29.3	(14)	16	20	0	20	(5)
2063	29.5	(14)	16	21	0	21	(5)
2064	29.8	(14)	16	21	0	21	(6)
2065	30.0	(14)	16	22	0	22	(6)
2066	30.2	(14)	16	23	0	23	(7)
2067	30.4	(14)	16	23	0	23	(7)
2068	30.6	(14)	16	24	0	24	(7)
2069	30.8	(15)	16	24	0	24	(8)
2070	31.0	(15)	16	25	0	25	(8)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Balch Springs' quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	84	0	0	0
1	2015	24,002	84	(2)	13	15
2	2016	24,486	84	(4)	13	17
3	2017	24,970	85	(5)	13	18
4	2018	25,455	85	(7)	13	20
5-year Goal	2019	25,939	85	(9)	13	22
6	2020	26,423	86	(19)	13	32
7	2021	26,679	87	(29)	13	42
8	2022	26,934	88	(39)	13	52
9	2023	27,190	89	(50)	13	62
10-year Goal	2024	27,446	90	(60)	13	73

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Balch Springs' most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	7.00	0	0	0
1	2015	24,002	7.00	0	(9)	(9)
2	2016	24,486	7.00	0	(9)	(9)
3	2017	24,970	7.00	0	(9)	(9)
4	2018	25,455	7.00	0	(9)	(9)
5-year Goal	2019	25,939	7.00	0	(9)	(9)
6	2020	26,423	7.20	(2)	(10)	(8)
7	2021	26,679	7.40	(4)	(10)	(6)
8	2022	26,934	7.60	(6)	(10)	(4)
9	2023	27,190	7.80	(8)	(10)	(2)
10-year Goal	2024	27,446	8.00	(10)	(10)	0

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 9 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
        i. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	TOTAL SAVINGS
2009		0
2010		0
2011	21.3	21.3
2012	21.5	21.5
2013	21.6	21.6
2014	21.7	21.7
2015	21.8	21.8
2016	21.9	21.9
2017	22.1	22.1
2018	22.2	22.2
2019	22.3	22.3
2020	22.4	22.4
2021	22.5	22.5
2022	22.6	22.6
2023	22.8	22.8
2024	22.9	22.9
2025	23.0	23.0
2026	23.1	23.1
2027	23.2	23.2
2028	23.4	23.4
2029	23.5	23.5
2030	23.6	23.6
2031	23.7	23.7
2032	23.9	23.9
2033	24.0	24.0
2034	24.1	24.1
2035	24.3	24.3
2036	24.4	24.4
2037	24.6	24.6
2038	24.7	24.7
2039	24.8	24.8
2040	25.0	25.0
2041	25.2	25.2
2042	25.4	25.4
2043	25.5	25.5
2044	25.7	25.7
2045	25.9	25.9
2046	26.1	26.1
2047	26.3	26.3
2048	26.5	26.5
2049	26.7	26.7
2050	26.8	26.8
2051	27.0	27.0
2052	27.3	27.3
2053	27.5	27.5
2054	27.7	27.7
2055	27.9	27.9
2056	28.1	28.1
2057	28.3	28.3
2058	28.5	28.5
2059	28.7	28.7
2060	28.9	28.9
2061	29.1	29.1
2062	29.3	29.3
2063	29.5	29.5
2064	29.8	29.8
2065	30.0	30.0
2066	30.2	30.2
2067	30.4	30.4
2068	30.6	30.6
2069	30.8	30.8
2070	31.0	31.0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	7.00	0
2015	24,002	8.00	(9)
2016	24,486	8.00	(9)
2017	24,970	8.00	(9)
2018	25,455	8.00	(9)
2019	25,939	8.00	(9)
2020	26,423	8.00	(10)
2021	26,679	8.00	(10)
2022	26,934	8.00	(10)
2023	27,190	8.00	(10)
2024	27,446	8.00	(10)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 70 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	(9)	13	70	2	3	4	79
2017	22	(9)	13	71	2	3	5	79
2018	22	(9)	13	71	2	4	6	78
2019	22	(9)	13	71	2	4	6	78
2020	22	(10)	13	72	3	5	7	77
2021	23	(10)	13	72	3	5	8	77
2022	23	(10)	13	72	4	5	8	77
2023	23	(10)	13	73	4	5	8	77
2024	23	(10)	13	73	4	5	9	77
2025	23	(10)	13	74	5	5	9	77
2026	23	(10)	13	74	5	5	9	77
2027	23	(10)	13	74	5	5	10	78
2028	23	(10)	13	75	6	5	10	78
2029	23	(10)	13	75	6	5	10	78
2030	24	(11)	13	75	6	5	11	78
2031	24	(11)	13	76	7	4	11	78
2032	24	(11)	13	76	7	4	11	79
2033	24	(11)	13	77	7	3	11	79
2034	24	(11)	13	77	8	3	10	80
2035	24	(11)	13	78	8	2	10	81
2036	24	(11)	13	78	9	2	10	81
2037	25	(11)	13	79	9	1	10	82
2038	25	(11)	13	79	9	1	10	82
2039	25	(11)	13	80	10	0	10	83
2040	25	(12)	13	80	10	0	10	83

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	(9)	13	12	2	3	4	21
2017	22	(9)	13	12	2	3	5	20
2018	22	(9)	13	12	2	4	6	19
2019	22	(9)	13	12	2	4	6	18
2020	22	(10)	13	12	3	5	7	17
2021	23	(10)	13	12	3	5	8	17
2022	23	(10)	13	12	4	5	8	17
2023	23	(10)	13	12	4	5	8	17
2024	23	(10)	13	12	4	5	9	16
2025	23	(10)	13	12	5	5	9	16
2026	23	(10)	13	12	5	5	9	16
2027	23	(10)	13	12	5	5	10	16
2028	23	(10)	13	13	6	5	10	15
2029	23	(10)	13	13	6	5	10	15
2030	24	(11)	13	13	6	5	11	15
2031	24	(11)	13	13	7	4	11	15
2032	24	(11)	13	13	7	4	11	15
2033	24	(11)	13	13	7	3	11	15
2034	24	(11)	13	13	8	3	10	16
2035	24	(11)	13	13	8	2	10	16
2036	24	(11)	13	13	9	2	10	16
2037	25	(11)	13	13	9	1	10	16
2038	25	(11)	13	13	9	1	10	16
2039	25	(11)	13	13	10	0	10	17
2040	25	(12)	13	13	10	0	10	17

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 18 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	(9)	13	18	2	3	4	26
2017	22	(9)	13	18	2	3	5	26
2018	22	(9)	13	18	2	4	6	25
2019	22	(9)	13	18	2	4	6	24
2020	22	(10)	13	18	3	5	7	23
2021	23	(10)	13	18	3	5	8	23
2022	23	(10)	13	18	4	5	8	23
2023	23	(10)	13	18	4	5	8	23
2024	23	(10)	13	18	4	5	9	22
2025	23	(10)	13	18	5	5	9	22
2026	23	(10)	13	18	5	5	9	22
2027	23	(10)	13	19	5	5	10	22
2028	23	(10)	13	19	6	5	10	22
2029	23	(10)	13	19	6	5	10	21
2030	24	(11)	13	19	6	5	11	21
2031	24	(11)	13	19	7	4	11	21
2032	24	(11)	13	19	7	4	11	22
2033	24	(11)	13	19	7	3	11	22
2034	24	(11)	13	19	8	3	10	22
2035	24	(11)	13	19	8	2	10	22
2036	24	(11)	13	20	9	2	10	22
2037	25	(11)	13	20	9	1	10	23
2038	25	(11)	13	20	9	1	10	23
2039	25	(11)	13	20	10	0	10	23
2040	25	(12)	13	20	10	0	10	23

4. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Bonham Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Bonham's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Bonham's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Bonham's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Bonham with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(21)	(21)	1	4	5	(26)
2016	0	(21)	(21)	1	5	6	(28)
2017	0	(22)	(22)	1	6	7	(29)
2018	0	(22)	(22)	2	7	9	(31)
2019	0	(23)	(23)	2	8	10	(32)
2020	0	(23)	(23)	2	9	11	(34)
2021	0	(24)	(24)	3	9	11	(35)
2022	0	(24)	(24)	3	8	11	(35)
2023	0	(25)	(25)	3	7	11	(35)
2024	0	(25)	(25)	4	7	10	(36)
2025	0	(26)	(26)	4	6	10	(36)
2026	0	(27)	(27)	4	6	10	(37)
2027	0	(27)	(27)	5	5	10	(37)
2028	0	(28)	(28)	5	4	9	(37)
2029	0	(29)	(29)	5	4	9	(38)
2030	0	(29)	(29)	6	3	9	(38)
2031	0	(30)	(30)	6	3	9	(39)
2032	0	(31)	(31)	7	3	9	(41)
2033	0	(32)	(32)	7	2	9	(42)
2034	0	(34)	(34)	8	2	10	(43)
2035	0	(35)	(35)	8	2	10	(45)
2036	0	(36)	(36)	9	1	10	(46)
2037	0	(37)	(37)	9	1	10	(47)
2038	0	(38)	(38)	10	1	11	(49)
2039	0	(39)	(39)	11	0	11	(50)
2040	0	(40)	(40)	11	0	11	(51)
2041	0	(42)	(42)	12	0	12	(54)
2042	0	(43)	(43)	13	0	13	(56)
2043	0	(45)	(45)	14	0	14	(58)
2044	0	(46)	(46)	15	0	15	(61)
2045	0	(47)	(47)	15	0	15	(63)
2046	0	(49)	(49)	16	0	16	(65)
2047	0	(50)	(50)	17	0	17	(68)
2048	0	(52)	(52)	18	0	18	(70)
2049	0	(53)	(53)	19	0	19	(72)
2050	0	(55)	(55)	20	0	20	(75)
2051	0	(56)	(56)	21	0	21	(77)
2052	0	(57)	(57)	22	0	22	(79)
2053	0	(59)	(59)	23	0	23	(82)
2054	0	(60)	(60)	24	0	24	(84)
2055	0	(61)	(61)	25	0	25	(86)
2056	0	(62)	(62)	26	0	26	(89)
2057	0	(64)	(64)	27	0	27	(91)
2058	0	(65)	(65)	28	0	28	(93)
2059	0	(66)	(66)	30	0	30	(96)
2060	0	(68)	(68)	31	0	31	(98)
2061	0	(69)	(69)	32	0	32	(101)
2062	0	(70)	(70)	34	0	34	(104)
2063	0	(72)	(72)	35	0	35	(107)
2064	0	(73)	(73)	36	0	36	(110)
2065	0	(75)	(75)	38	0	38	(113)
2066	0	(76)	(76)	39	0	39	(116)
2067	0	(78)	(78)	41	0	41	(118)
2068	0	(79)	(79)	42	0	42	(121)
2069	0	(81)	(81)	44	0	44	(124)
2070	0	(82)	(82)	45	0	45	(127)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Bonham's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-		0	0	0
1	2015	11,456	29	(120)	(21)	100
2	2016	11,685	58	(246)	(21)	224
3	2017	11,915	86	(376)	(22)	354
4	2018	12,144	115	(511)	(22)	488
5-year Goal	2019	12,374	144	(650)	(23)	628
6	2020	12,603	143	(660)	(23)	637
7	2021	12,943	143	(675)	(24)	651
8	2022	13,282	142	(689)	(24)	665
9	2023	13,622	142	(704)	(25)	679
10-year Goal	2024	13,962	141	(719)	(25)	693

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Bonham's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-		0	0	0
1	2015	11,456	4.00	(17)	(21)	(4)
2	2016	11,685	8.00	(34)	(21)	13
3	2017	11,915	12.00	(52)	(22)	30
4	2018	12,144	16.00	(71)	(22)	49
5-year Goal	2019	12,374	20.00	(90)	(23)	68
6	2020	12,603	19.80	(91)	(23)	68
7	2021	12,943	19.60	(93)	(24)	69
8	2022	13,282	19.40	(94)	(24)	70
9	2023	13,622	19.20	(95)	(25)	71
10-year Goal	2024	13,962	19.00	(97)	(25)	71

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 21 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	11,456	25.00	(21)
2016	11,685	25.00	(21)
2017	11,915	25.00	(22)
2018	12,144	25.00	(22)
2019	12,374	25.00	(23)
2020	12,603	25.00	(23)
2021	12,943	25.00	(24)
2022	13,282	25.00	(24)
2023	13,622	25.00	(25)
2024	13,962	25.00	(25)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - **b.** Savings could be 36 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(21)	(21)	36	1	5	6	9
2017	0	(22)	(22)	37	1	6	7	8
2018	0	(22)	(22)	38	2	7	9	8
2019	0	(23)	(23)	39	2	8	10	7
2020	0	(23)	(23)	40	2	9	11	6
2021	0	(24)	(24)	41	3	9	11	6
2022	0	(24)	(24)	42	3	8	11	7
2023	0	(25)	(25)	43	3	7	11	8
2024	0	(25)	(25)	44	4	7	10	8
2025	0	(26)	(26)	45	4	6	10	9
2026	0	(27)	(27)	46	4	6	10	9
2027	0	(27)	(27)	47	5	5	10	10
2028	0	(28)	(28)	48	5	4	9	11
2029	0	(29)	(29)	49	5	4	9	11
2030	0	(29)	(29)	50	6	3	9	12
2031	0	(30)	(30)	52	6	3	9	12
2032	0	(31)	(31)	53	7	3	9	13
2033	0	(32)	(32)	55	7	2	9	13
2034	0	(34)	(34)	57	8	2	10	14
2035	0	(35)	(35)	59	8	2	10	14
2036	0	(36)	(36)	60	9	1	10	15
2037	0	(37)	(37)	62	9	1	10	15
2038	0	(38)	(38)	64	10	1	11	15
2039	0	(39)	(39)	66	11	0	11	16
2040	0	(40)	(40)	68	11	0	11	16

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[17]
g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(21)	(21)	8	1	5	6	(20)
2017	0	(22)	(22)	8	1	6	7	(21)
2018	0	(22)	(22)	8	2	7	9	(22)
2019	0	(23)	(23)	9	2	8	10	(24)
2020	0	(23)	(23)	9	2	9	11	(26)
2021	0	(24)	(24)	9	3	9	11	(26)
2022	0	(24)	(24)	9	3	8	11	(26)
2023	0	(25)	(25)	9	3	7	11	(26)
2024	0	(25)	(25)	10	4	7	10	(26)
2025	0	(26)	(26)	10	4	6	10	(26)
2026	0	(27)	(27)	10	4	6	10	(26)
2027	0	(27)	(27)	10	5	5	10	(27)
2028	0	(28)	(28)	11	5	4	9	(27)
2029	0	(29)	(29)	11	5	4	9	(27)
2030	0	(29)	(29)	11	6	3	9	(27)
2031	0	(30)	(30)	11	6	3	9	(28)
2032	0	(31)	(31)	12	7	3	9	(29)
2033	0	(32)	(32)	12	7	2	9	(30)
2034	0	(34)	(34)	12	8	2	10	(31)
2035	0	(35)	(35)	13	8	2	10	(32)
2036	0	(36)	(36)	13	9	1	10	(33)
2037	0	(37)	(37)	14	9	1	10	(34)
2038	0	(38)	(38)	14	10	1	11	(35)
2039	0	(39)	(39)	14	11	0	11	(35)
2040	0	(40)	(40)	15	11	0	11	(36)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 12 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(21)	(21)	12	1	5	6	(16)
2017	0	(22)	(22)	12	1	6	7	(17)
2018	0	(22)	(22)	13	2	7	9	(18)
2019	0	(23)	(23)	13	2	8	10	(20)
2020	0	(23)	(23)	13	2	9	11	(21)
2021	0	(24)	(24)	14	3	9	11	(21)
2022	0	(24)	(24)	14	3	8	11	(21)
2023	0	(25)	(25)	14	3	7	11	(21)
2024	0	(25)	(25)	14	4	7	10	(21)
2025	0	(26)	(26)	15	4	6	10	(21)
2026	0	(27)	(27)	15	4	6	10	(21)
2027	0	(27)	(27)	15	5	5	10	(22)
2028	0	(28)	(28)	16	5	4	9	(22)
2029	0	(29)	(29)	16	5	4	9	(22)
2030	0	(29)	(29)	16	6	3	9	(22)
2031	0	(30)	(30)	17	6	3	9	(22)
2032	0	(31)	(31)	17	7	3	9	(23)
2033	0	(32)	(32)	18	7	2	9	(24)
2034	0	(34)	(34)	19	8	2	10	(25)
2035	0	(35)	(35)	19	8	2	10	(25)
2036	0	(36)	(36)	20	9	1	10	(26)
2037	0	(37)	(37)	20	9	1	10	(27)
2038	0	(38)	(38)	21	10	1	11	(28)
2039	0	(39)	(39)	22	11	0	11	(28)
2040	0	(40)	(40)	22	11	0	11	(29)

4. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Carrollton Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 20156j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Carrollton's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Carrollton's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Carrollton's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Carrollton with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(47)	(47)	46	17	63	(110)
2016	62	(47)	15	57	21	78	(64)
2017	123	(47)	76	57	26	83	(7)
2018	123	(47)	76	68	30	98	(22)
2019	123	(47)	76	80	34	114	(38)
2020	123	(47)	76	103	38	141	(65)
2021	123	(47)	76	109	38	147	(72)
2022	123	(47)	76	115	38	154	(78)
2023	123	(47)	76	122	38	160	(84)
2024	123	(47)	76	128	38	167	(91)
2025	123	(47)	76	134	38	173	(97)
2026	123	(47)	76	141	38	179	(104)
2027	123	(47)	76	147	38	186	(110)
2028	123	(47)	75	153	38	192	(116)
2029	123	(47)	75	160	38	198	(123)
2030	123	(47)	75	166	38	205	(129)
2031	122	(47)	75	172	35	207	(132)
2032	122	(47)	75	178	31	209	(134)
2033	122	(47)	75	184	27	211	(136)
2034	122	(47)	75	190	23	213	(139)
2035	122	(47)	74	196	19	215	(141)
2036	121	(47)	74	202	15	217	(143)
2037	121	(47)	74	208	12	219	(146)
2038	121	(47)	74	214	8	222	(148)
2039	121	(47)	74	220	4	224	(150)
2040	121	(47)	73	226	0	226	(152)
2041	120	(47)	73	228	0	228	(155)
2042	120	(47)	73	230	0	230	(157)
2043	120	(47)	73	233	0	233	(160)
2044	120	(47)	73	235	0	235	(162)
2045	120	(47)	73	237	0	237	(164)
2046	120	(47)	73	240	0	240	(167)
2047	120	(47)	73	242	0	242	(169)
2048	120	(47)	72	244	0	244	(172)
2049	119	(47)	72	246	0	246	(174)
2050	119	(47)	72	249	0	249	(176)
2051	119	(47)	72	251	0	251	(179)
2052	119	(47)	72	254	0	254	(181)
2053	119	(47)	72	256	0	256	(184)
2054	119	(47)	72	258	0	258	(186)
2055	119	(47)	72	261	0	261	(189)
2056	119	(47)	72	263	0	263	(191)
2057	119	(47)	72	266	0	266	(194)
2058	119	(47)	72	268	0	268	(196)
2059	119	(47)	72	271	0	271	(199)
2060	119	(47)	72	273	0	273	(201)
2061	119	(47)	72	276	0	276	(204)
2062	119	(47)	72	278	0	278	(206)
2063	119	(47)	72	281	0	281	(209)
2064	119	(47)	72	283	0	283	(211)
2065	119	(47)	72	285	0	285	(213)
2066	119	(47)	72	288	0	288	(216)
2067	119	(47)	72	290	0	290	(218)
2068	119	(47)	72	293	0	293	(221)
2069	119	(47)	72	295	0	295	(223)
2070	119	(47)	72	298	0	298	(226)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Carrollton's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	170	0	0	0
1	2015	128,353	170	9	(47)	(56)
2	2016	128,451	170	19	15	(4)
3	2017	128,549	169	28	76	48
4	2018	128,648	169	38	76	38
5-year Goal	2019	128,746	169	47	76	29
6	2020	128,844	169	66	76	10
7	2021	128,877	168	85	76	(9)
8	2022	128,910	168	104	76	(28)
9	2023	128,944	167	122	76	(47)
10-year Goal	2024	128,977	167	141	76	(66)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Carrollton's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2015	128,353	9.00	0	(47)	(47)
2	2016	128,451	9.00	0	(47)	(47)
3	2017	128,549	9.00	0	(47)	(47)
4	2018	128,648	9.00	0	(47)	(47)
5-year Goal	2019	128,746	9.00	0	(47)	(47)
6	2020	128,844	9.00	0	(47)	(47)
7	2021	128,877	9.00	0	(47)	(47)
8	2022	128,910	9.00	0	(47)	(47)
9	2023	128,944	9.00	0	(47)	(47)
10-year Goal	2024	128,977	9.00	0	(47)	(47)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 47 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 4.0% increase in 2016
        ii. 4.0% increase in 2017
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999) Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Outdoor Watering Ordinances	Conservation Pricing/Rate Increases	Irrigation System Permits	Stormwater Landscape Ordinance (ICI)	WaterWise Take-home Kits	Water Waste Violations + Inspections	Rainwater Harvesting	TOTAL SAVINGS
2010	Variable	1,122	54	6	0	26	23.5	1,231
2011	Variable	1,144	72	6	0.2	94	26.1	1,342
2012	3,316	1,167	90	6	0.4	135	26.5	4,741
2013	3,380	1,189	107	6	0.7	156	27.0	4,866
2014	3,443	1,211	125	6	0.9	152	27.9	4,967
2015	3,507	1,727	143	6	0.9	161	28.3	5,574
2016	6,887	2,060	161	6	0.7	115	25.5	9,256
2017	7,009	2,097	179	7	0.5	50	22.6	9,365
2018	7,132	2,133	161	7	0.2	0.2	19.8	9,453
2019	7,255	2,170	143	7			17.0	9,592
2020	7,377	2,207	125	7			16.1	9,732
2021	7,500	2,243	107	7			13.5	9,871
2022	7,622	2,280	90	7			10.3	10,009
2023	7,745	2,317	72	7			7.0	10,148
2024	7,868	2,353	54	7			3.2	10,285
2025	7,990	2,390	36	8				10,424
2026	8,113	2,427	18	8				10,565
2027	8,235	2,463		8				10,707
2028	8,358	2,500		8				10,866
2029	8,480	2,537		8				11,025
2030	8,603	2,574		8				11,185
2031	8,735	2,613		8				11,356
2032	8,866	2,652		9				11,527
2033	8,998	2,692		9				11,698
2034	9,129	2,731		9				11,869
2035	9,261	2,770		9				12,040
2036	9,393	2,810		9				12,211
2037	9,524	2,849		9				12,383
2038	9,656	2,888		9				12,554
2039	9,787	2,928		9				12,725
2040	9,919	2,967		10				12,896
2041	10,021	2,998		10				13,028
2042	10,123	3,028		10				13,160
2043	10,224	3,058		10				13,293
2044	10,326	3,089		10				13,425
2045	10,428	3,119		10				13,557
2046	10,529	3,150		10				13,689
2047	10,631	3,180		10				13,822
2048	10,733	3,211		10				13,954
2049	10,835	3,241		11				14,086
2050	10,936	3,271		11				14,218
2051	11,027	3,299		11				14,337
2052	11,118	3,326		11				14,455
2053	11,210	3,353		11				14,574
2054	11,301	3,380		11				14,692
2055	11,392	3,408		11				14,811
2056	11,483	3,435		11				14,929
2057	11,574	3,462		11				15,048
2058	11,665	3,490		11				15,166
2059	11,756	3,517		11				15,285
2060	11,847	3,544		12				15,403
2061	11,955	3,576		12				15,543
2062	12,063	3,609		12				15,683
2063	12,171	3,641		12				15,824
2064	12,279	3,673		12				15,964
2065	12,386	3,705		12				16,104
2066	12,494	3,738		12				16,244
2067	12,602	3,770		12				16,384
2068	12,710	3,802		12				16,524
2069	12,818	3,834		13				16,664
2070	12,925	3,867		13				16,805

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	128,353	10.00	(47)
2016	128,451	10.00	(47)
2017	128,549	10.00	(47)
2018	128,648	10.00	(47)
2019	128,746	10.00	(47)
2020	128,844	10.00	(47)
2021	128,877	10.00	(47)
2022	128,910	10.00	(47)
2023	128,944	10.00	(47)
2024	128,977	10.00	(47)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region C savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 615 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	62	(47)	15	615	57	21	78	551
2017	123	(47)	76	615	57	26	83	608
2018	123	(47)	76	615	68	30	98	592
2019	123	(47)	76	615	80	34	114	576
2020	123	(47)	76	614	103	38	141	549
2021	123	(47)	76	614	109	38	147	543
2022	123	(47)	76	614	115	38	154	536
2023	123	(47)	76	614	122	38	160	529
2024	123	(47)	76	614	128	38	167	523
2025	123	(47)	76	614	134	38	173	516
2026	123	(47)	76	613	141	38	179	510
2027	123	(47)	76	613	147	38	186	503
2028	123	(47)	75	613	153	38	192	497
2029	123	(47)	75	613	160	38	198	490
2030	123	(47)	75	613	166	38	205	484
2031	122	(47)	75	612	172	35	207	480
2032	122	(47)	75	611	178	31	209	477
2033	122	(47)	75	610	184	27	211	474
2034	122	(47)	75	609	190	23	213	470
2035	122	(47)	74	608	196	19	215	467
2036	121	(47)	74	607	202	15	217	463
2037	121	(47)	74	606	208	12	219	460
2038	121	(47)	74	605	214	8	222	457
2039	121	(47)	74	604	220	4	224	453
2040	121	(47)	73	603	226	0	226	450

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	62	(47)	15	103	57	21	78	39
2017	123	(47)	76	103	57	26	83	96
2018	123	(47)	76	103	68	30	98	81
2019	123	(47)	76	103	80	34	114	65
2020	123	(47)	76	103	103	38	141	38
2021	123	(47)	76	103	109	38	147	31
2022	123	(47)	76	103	115	38	154	25
2023	123	(47)	76	103	122	38	160	18
2024	123	(47)	76	103	128	38	167	12
2025	123	(47)	76	103	134	38	173	6
2026	123	(47)	76	103	141	38	179	(1)
2027	123	(47)	76	103	147	38	186	(7)
2028	123	(47)	75	103	153	38	192	(14)
2029	123	(47)	75	103	160	38	198	(20)
2030	123	(47)	75	103	166	38	205	(27)
2031	122	(47)	75	102	172	35	207	(29)
2032	122	(47)	75	102	178	31	209	(32)
2033	122	(47)	75	102	184	27	211	(34)
2034	122	(47)	75	102	190	23	213	(37)
2035	122	(47)	74	102	196	19	215	(39)
2036	121	(47)	74	102	202	15	217	(42)
2037	121	(47)	74	101	208	12	219	(44)
2038	121	(47)	74	101	214	8	222	(47)
2039	121	(47)	74	101	220	4	224	(49)
2040	121	(47)	73	101	226	0	226	(52)

3. Rain Barrels

  a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

  b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Cedar Hill Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Cedar Hill's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Cedar Hill's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Cedar Hill's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Cedar Hill with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	115	496	611	24	8	31	579
2016	118	505	623	29	10	39	584
2017	120	515	635	29	12	41	594
2018	123	525	647	35	13	49	598
2019	125	534	659	41	15	57	603
2020	128	544	672	53	17	70	601
2021	130	556	686	58	17	75	611
2022	133	568	701	63	17	81	620
2023	136	580	716	69	17	86	630
2024	138	592	731	74	17	91	640
2025	141	605	745	79	17	96	649
2026	143	617	760	84	17	101	659
2027	146	629	775	89	17	107	668
2028	148	641	790	95	17	112	678
2029	151	653	804	100	17	117	687
2030	154	666	819	105	17	122	697
2031	156	678	834	111	16	127	707
2032	159	690	849	117	14	131	718
2033	162	702	864	123	12	135	728
2034	164	714	878	129	10	139	739
2035	167	726	893	135	9	144	750
2036	169	739	908	141	7	148	760
2037	172	751	923	147	5	152	771
2038	175	763	938	153	3	156	781
2039	177	775	952	159	2	161	792
2040	180	787	967	165	0	165	802
2041	183	800	982	169	0	169	813
2042	185	812	997	174	0	174	823
2043	188	824	1,012	178	0	178	834
2044	191	836	1,027	183	0	183	844
2045	193	848	1,042	187	0	187	855
2046	196	860	1,056	191	0	191	865
2047	199	873	1,071	196	0	196	876
2048	201	885	1,086	200	0	200	886
2049	204	897	1,101	205	0	205	896
2050	207	909	1,116	209	0	209	907
2051	207	909	1,116	211	0	211	905
2052	207	909	1,116	213	0	213	903
2053	207	909	1,116	214	0	214	901
2054	207	909	1,116	216	0	216	900
2055	207	909	1,116	218	0	218	898
2056	207	909	1,116	220	0	220	896
2057	207	909	1,116	222	0	222	894
2058	207	909	1,116	223	0	223	892
2059	207	909	1,116	225	0	225	891
2060	207	909	1,116	227	0	227	889
2061	207	909	1,116	229	0	229	887
2062	207	909	1,116	231	0	231	885
2063	207	909	1,116	233	0	233	883
2064	207	909	1,116	235	0	235	881
2065	207	909	1,116	237	0	237	879
2066	207	909	1,116	238	0	238	877
2067	207	909	1,116	240	0	240	875
2068	207	909	1,116	242	0	242	874
2069	207	909	1,116	244	0	244	872
2070	207	909	1,116	246	0	246	870

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Cedar Hill's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	177	0	0	0
1	2015	48,507	176	25	611	586
2	2016	49,446	174	51	623	572
3	2017	50,384	173	77	635	558
4	2018	51,323	171	105	647	542
5-year Goal	2019	52,261	170	134	659	526
6	2020	53,200	170	144	672	528
7	2021	54,392	169	155	686	531
8	2022	55,584	169	166	701	535
9	2023	56,776	168	178	716	538
10-year Goal	2024	57,968	168	190	731	540

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Cedar Hill's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	42.00	0	0	0
1	2015	48,507	40.00	35	496	460
2	2016	49,446	38.00	72	505	433
3	2017	50,384	36.00	110	515	405
4	2018	51,323	34.00	150	525	375
5-year Goal	2019	52,261	32.00	191	534	343
6	2020	53,200	30.60	221	544	322
7	2021	54,392	29.20	254	556	302
8	2022	55,584	27.80	288	568	280
9	2023	56,776	26.40	323	580	257
10-year Goal	2024	57,968	25.00	360	592	233

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 496 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 11.0% increase in 2013
    b. Estimated customer demand reduction of 2.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**
    a. Implemented in 2013
    b. Estimated savings of 47.2 MG in 2016
        i. Specific utility results may vary based on portal features and notifications
    c. Assumes 20% of residential customers are using and saving water due to the portal (Westin Engineering, 2015)
    d. Assumes customers save 10% of total annual use due to the portal

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

[17] Correspondence with utility staff.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

        i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
    e. Residential customers' use makes up approximately 74% of all retail customers' use based on utility profile information submitted to the TWDB
    f. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.48% of total demand
    g. Savings are assumed to increase along with demand as connections increase each year[19]
    h. Savings estimate may vary with specific features of FATHOM U2You portal

6. Rain Barrels

    a. In Region C, estimated savings of 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
        i. Estimated 10-year useful life for most barrels

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	AMI with Customer Portal	Water Rate Increase	TOTAL SAVINGS
2012				0
2013		44.1	66	110
2014		45.1	67	112
2015		46.2	69	115
2016	0.1	47.2	70	118
2017	0.1	48.3	72	120
2018	0.1	49.3	73	123
2019	0.1	50.3	75	125
2020	0.1	51.4	76	128
2021	0.1	52.4	78	130
2022	0.1	53.5	79	133
2023	0.1	54.5	81	136
2024	0.1	55.5	83	138
2025	0.1	56.6	84	141
2026		57.6	86	143
2027		58.7	87	146
2028		59.7	89	148
2029		60.7	90	151
2030		61.8	92	154
2031		62.8	93	156
2032		63.9	95	159
2033		65.0	97	162
2034		66.0	98	164
2035		67.1	100	167
2036		68.1	101	169
2037		69.2	103	172
2038		70.3	104	175
2039		71.3	106	177
2040		72.4	108	180
2041		73.5	109	183
2042		74.5	111	185
2043		75.6	112	188
2044		76.7	114	191
2045		77.8	116	193
2046		78.9	117	196
2047		79.9	119	199
2048		81.0	120	201
2049		82.1	122	204
2050		83.2	124	207
2051		83.2	124	207
2052		83.2	124	207
2053		83.2	124	207
2054		83.1	124	207
2055		83.1	124	207
2056		83.1	124	207
2057		83.1	124	207
2058		83.1	124	207
2059		83.1	124	207
2060		83.1	124	207
2061		83.1	124	207
2062		83.1	124	207
2063		83.1	124	207
2064		83.1	124	207
2065		83.1	124	207
2066		83.1	124	207
2067		83.1	124	207
2068		83.1	124	207
2069		83.1	124	207
2070		83.1	124	207

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	42.00	0
2015	48,507	14.00	496
2016	49,446	14.00	505
2017	50,384	14.00	515
2018	51,323	14.00	525
2019	52,261	14.00	534
2020	53,200	14.00	544
2021	54,392	14.00	556
2022	55,584	14.00	568
2023	56,776	14.00	580
2024	57,968	14.00	592

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 255 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	118	505	623	255	29	10	39	839
2017	120	515	635	261	29	12	41	855
2018	123	525	647	266	35	13	49	865
2019	125	534	659	272	41	15	57	875
2020	128	544	672	278	53	17	70	879
2021	130	556	686	283	58	17	75	894
2022	133	568	701	289	63	17	81	909
2023	136	580	716	295	69	17	86	925
2024	138	592	731	300	74	17	91	940
2025	141	605	745	306	79	17	96	955
2026	143	617	760	311	84	17	101	970
2027	146	629	775	317	89	17	107	985
2028	148	641	790	323	95	17	112	1,000
2029	151	653	804	328	100	17	117	1,016
2030	154	666	819	334	105	17	122	1,031
2031	156	678	834	340	111	16	127	1,047
2032	159	690	849	345	117	14	131	1,063
2033	162	702	864	351	123	12	135	1,080
2034	164	714	878	357	129	10	139	1,096
2035	167	726	893	363	135	9	144	1,112
2036	169	739	908	368	141	7	148	1,128
2037	172	751	923	374	147	5	152	1,145
2038	175	763	938	380	153	3	156	1,161
2039	177	775	952	385	159	2	161	1,177
2040	180	787	967	391	165	0	165	1,193

Statewide Water Conservation Quantification Project
City of Cockrell Hill Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Cockrell Hill's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Cockrell Hill's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Cockrell Hill's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Cockrell Hill with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	1.70	2	0	0	0	1
2016	8.6	1.73	10	0	0	1	10
2017	8.6	1.75	10	0	0	1	10
2018	8.6	1.78	10	0	1	1	10
2019	8.6	1.80	10	0	1	1	10
2020	8.6	1.83	10	0	1	1	9
2021	8.6	1.83	10	0	1	1	9
2022	8.6	1.84	10	0	1	1	9
2023	8.6	1.84	10	1	1	1	9
2024	8.6	1.84	10	1	1	1	9
2025	8.6	1.85	10	1	1	1	9
2026	8.6	1.85	10	1	1	1	9
2027	8.6	1.86	10	1	1	1	9
2028	8.6	1.86	10	1	1	1	9
2029	8.6	1.87	10	1	1	2	9
2030	8.6	1.87	10	1	1	2	9
2031	8.6	1.87	10	1	1	2	9
2032	8.6	1.87	10	1	1	2	9
2033	8.6	1.87	10	1	0	2	9
2034	8.6	1.87	10	1	0	1	9
2035	8.6	1.87	10	1	0	1	9
2036	8.6	1.87	10	1	0	1	9
2037	8.6	1.87	10	1	0	1	9
2038	8.6	1.87	10	1	0	1	9
2039	8.6	1.87	10	1	0	1	9
2040	8.6	1.87	10	1	0	1	9
2041	8.6	1.87	10	1	0	1	9
2042	8.6	1.87	10	1	0	1	9
2043	8.6	1.87	10	1	0	1	9
2044	8.6	1.87	10	1	0	1	9
2045	8.6	1.87	10	1	0	1	9
2046	8.6	1.87	10	1	0	1	9
2047	8.6	1.87	10	2	0	2	9
2048	8.6	1.87	10	2	0	2	9
2049	8.6	1.87	10	2	0	2	9
2050	8.6	1.87	10	2	0	2	9
2051	8.6	1.94	10	2	0	2	9
2052	8.6	2.01	11	2	0	2	9
2053	8.6	2.08	11	2	0	2	9
2054	8.6	2.14	11	2	0	2	9
2055	8.6	2.21	11	2	0	2	8
2056	8.6	2.28	11	2	0	2	8
2057	8.6	2.35	11	3	0	3	8
2058	8.6	2.42	11	3	0	3	8
2059	8.6	2.49	11	3	0	3	8
2060	8.6	2.56	11	3	0	3	8
2061	8.6	2.85	11	3	0	3	8
2062	8.6	3.14	12	4	0	4	8
2063	8.6	3.43	12	4	0	4	8
2064	8.6	3.72	12	5	0	5	8
2065	8.6	4.02	13	5	0	5	7
2066	8.6	4.31	13	6	0	6	7
2067	8.6	4.60	13	6	0	6	7
2068	8.6	4.89	13	7	0	7	7
2069	8.6	5.18	14	7	0	7	7
2070	8.6	5.48	14	7	0	7	7

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Cockrell Hill's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	100	0	0	0
1	2015	4,670	100	0	2	2
2	2016	4,738	100	0	10	10
3	2017	4,805	100	0	10	10
4	2018	4,873	100	0	10	10
5-year Goal	2019	4,940	100	0	10	10
6	2020	5,008	100	0	10	10
7	2021	5,019	100	0	10	10
8	2022	5,031	100	0	10	10
9	2023	5,042	100	0	10	10
10-year Goal	2024	5,054	100	0	10	10

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Cockrell Hill's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2015	4,670	18.46	1	2	1
2	2016	4,738	17.92	2	2	(0)
3	2017	4,805	17.38	3	2	(1)
4	2018	4,873	16.84	4	2	(2)
5-year Goal	2019	4,940	16.30	5	2	(3)
6	2020	5,008	16.00	5	2	(4)
7	2021	5,019	15.70	6	2	(4)
8	2022	5,031	15.40	7	2	(5)
9	2023	5,042	15.10	7	2	(5)
10-year Goal	2024	5,054	14.80	8	2	(6)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 1.7 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Save Water Co. Commercial, Multi-family and Hotel Programs**[17]
    a. Project initiated in service area in 2016
    b. Save Water completed work on 116 multi-family units in 2016
    c. Average monthly savings of 713,185 gallons
    d. Annualized savings of 8.6 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Save Water Co. Program	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015		0
2016	9	8.6
2017	9	8.6
2018	9	8.6
2019	9	8.6
2020	9	8.6
2021	9	8.6
2022	9	8.6
2023	9	8.6
2024	9	8.6
2025	9	8.6
2026	9	8.6
2027	9	8.6
2028	9	8.6
2029	9	8.6
2030	9	8.6
2031	9	8.6
2032	9	8.6
2033	9	8.6
2034	9	8.6
2035	9	8.6
2036	9	8.6
2037	9	8.6
2038	9	8.6
2039	9	8.6
2040	9	8.6
2041	9	8.6
2042	9	8.6
2043	9	8.6
2044	9	8.6
2045	9	8.6
2046	9	8.6
2047	9	8.6
2048	9	8.6
2049	9	8.6
2050	9	8.6
2051	9	8.6
2052	9	8.6
2053	9	8.6
2054	9	8.6
2055	9	8.6
2056	9	8.6
2057	9	8.6
2058	9	8.6
2059	9	8.6
2060	9	8.6
2061	9	8.6
2062	9	8.6
2063	9	8.6
2064	9	8.6
2065	9	8.6
2066	9	8.6
2067	9	8.6
2068	9	8.6
2069	9	8.6
2070	9	8.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	19.00	0
2015	4,670	18.00	2
2016	4,738	18.00	2
2017	4,805	18.00	2
2018	4,873	18.00	2
2019	4,940	18.00	2
2020	5,008	18.00	2
2021	5,019	18.00	2
2022	5,031	18.00	2
2023	5,042	18.00	2
2024	5,054	18.00	2

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region C savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 10 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	9	2	10	10	0	0	1	20
2017	9	2	10	11	0	0	1	20
2018	9	2	10	11	0	1	1	20
2019	9	2	10	11	0	1	1	20
2020	9	2	10	11	0	1	1	20
2021	9	2	10	11	0	1	1	20
2022	9	2	10	11	0	1	1	20
2023	9	2	10	11	1	1	1	20
2024	9	2	10	11	1	1	1	20
2025	9	2	10	11	1	1	1	20
2026	9	2	10	11	1	1	1	20
2027	9	2	10	11	1	1	1	20
2028	9	2	10	11	1	1	1	20
2029	9	2	10	11	1	1	2	20
2030	9	2	10	11	1	1	2	20
2031	9	2	10	11	1	1	2	20
2032	9	2	10	11	1	1	2	20
2033	9	2	10	11	1	0	2	20
2034	9	2	10	11	1	0	1	20
2035	9	2	10	11	1	0	1	20
2036	9	2	10	11	1	0	1	20
2037	9	2	10	11	1	0	1	20
2038	9	2	10	11	1	0	1	20
2039	9	2	10	11	1	0	1	20
2040	9	2	10	11	1	0	1	20

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	9	2	10	2	0	0	1	11
2017	9	2	10	2	0	0	1	11
2018	9	2	10	2	0	1	1	11
2019	9	2	10	2	0	1	1	11
2020	9	2	10	2	0	1	1	11
2021	9	2	10	2	0	1	1	11
2022	9	2	10	2	0	1	1	11
2023	9	2	10	2	1	1	1	11
2024	9	2	10	2	1	1	1	11
2025	9	2	10	2	1	1	1	11
2026	9	2	10	2	1	1	1	11
2027	9	2	10	2	1	1	1	11
2028	9	2	10	2	1	1	1	11
2029	9	2	10	2	1	1	2	11
2030	9	2	10	2	1	1	2	11
2031	9	2	10	2	1	1	2	11
2032	9	2	10	2	1	1	2	11
2033	9	2	10	2	1	0	2	11
2034	9	2	10	2	1	0	1	11
2035	9	2	10	2	1	0	1	11
2036	9	2	10	2	1	0	1	11
2037	9	2	10	2	1	0	1	11
2038	9	2	10	2	1	0	1	11
2039	9	2	10	2	1	0	1	11
2040	9	2	10	2	1	0	1	11

3. Water Rate Increase

- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 3 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	9	2	10	3	0	0	1	12
2017	9	2	10	3	0	0	1	12
2018	9	2	10	3	0	1	1	12
2019	9	2	10	3	0	1	1	12
2020	9	2	10	3	0	1	1	12
2021	9	2	10	3	0	1	1	12
2022	9	2	10	3	0	1	1	12
2023	9	2	10	3	1	1	1	12
2024	9	2	10	3	1	1	1	12
2025	9	2	10	3	1	1	1	12
2026	9	2	10	3	1	1	1	12
2027	9	2	10	3	1	1	1	12
2028	9	2	10	3	1	1	1	12
2029	9	2	10	3	1	1	2	12
2030	9	2	10	3	1	1	2	12
2031	9	2	10	3	1	1	2	12
2032	9	2	10	3	1	1	2	12
2033	9	2	10	3	1	0	2	12
2034	9	2	10	3	1	0	1	12
2035	9	2	10	3	1	0	1	12
2036	9	2	10	3	1	0	1	12
2037	9	2	10	3	1	0	1	12
2038	9	2	10	3	1	0	1	12
2039	9	2	10	3	1	0	1	12
2040	9	2	10	3	1	0	1	12

4. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Colleyville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Colleyville's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Colleyville's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Colleyville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Colleyville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	62	65	127	18	7	25	102
2016	62	64	127	22	9	31	96
2017	63	64	126	22	10	33	94
2018	63	63	126	27	12	39	87
2019	63	62	126	31	14	45	80
2020	64	61	125	40	15	56	69
2021	64	62	126	43	15	59	67
2022	64	62	127	46	15	61	65
2023	65	62	127	49	15	64	63
2024	65	63	128	52	15	67	61
2025	65	63	129	55	15	70	59
2026	66	64	129	58	15	73	56
2027	66	64	130	60	15	76	54
2028	66	64	131	63	15	79	52
2029	67	65	132	66	15	82	50
2030	67	65	132	69	15	84	48
2031	67	66	133	72	14	86	47
2032	68	66	134	75	12	88	46
2033	68	66	134	79	11	89	45
2034	69	67	135	82	9	91	44
2035	69	67	136	85	8	93	43
2036	69	67	137	88	6	94	42
2037	70	68	137	91	5	96	42
2038	70	68	138	94	3	97	41
2039	70	69	139	98	2	99	40
2040	71	69	140	101	0	101	39
2041	71	69	140	102	0	102	38
2042	71	69	141	104	0	104	37
2043	71	70	141	105	0	105	36
2044	72	70	142	107	0	107	35
2045	72	70	142	108	0	108	34
2046	72	71	143	110	0	110	33
2047	72	71	143	111	0	111	32
2048	72	71	143	113	0	113	31
2049	73	71	144	114	0	114	30
2050	73	72	144	116	0	116	29
2051	73	72	144	117	0	117	28
2052	73	72	144	118	0	118	26
2053	73	72	144	119	0	119	25
2054	73	72	144	120	0	120	24
2055	73	72	144	121	0	121	23
2056	73	72	144	123	0	123	22
2057	73	72	144	124	0	124	21
2058	73	72	144	125	0	125	20
2059	73	72	144	126	0	126	18
2060	73	72	144	127	0	127	17
2061	73	72	144	128	0	128	16
2062	73	72	144	129	0	129	15
2063	73	72	144	131	0	131	14
2064	73	72	144	132	0	132	13
2065	73	72	144	133	0	133	11
2066	73	72	144	134	0	134	10
2067	73	72	144	135	0	135	9
2068	73	72	144	136	0	136	8
2069	73	72	144	138	0	138	7
2070	73	72	144	139	0	139	6

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Colleyville's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	299	0	0	0
1	2015	25,487	296	28	127	99
2	2016	25,190	293	55	127	72
3	2017	24,892	290	82	126	45
4	2018	24,595	287	108	126	18
5-year Goal	2019	24,297	284	133	126	(7)
6	2020	24,000	281	156	125	(31)
7	2021	24,150	278	182	126	(56)
8	2022	24,300	276	208	127	(81)
9	2023	24,450	273	234	127	(107)
10-year Goal	2024	24,600	270	260	128	(132)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Colleyville's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2015	25,487	14.00	0	65	65
2	2016	25,190	14.00	0	64	64
3	2017	24,892	14.00	0	64	64
4	2018	24,595	14.00	0	63	63
5-year Goal	2019	24,297	14.00	0	62	62
6	2020	24,000	14.00	0	61	61
7	2021	24,150	14.00	0	62	62
8	2022	24,300	14.00	0	62	62
9	2023	24,450	14.00	0	62	62
10-year Goal	2024	24,600	14.00	0	63	63

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 65 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 4.0% increase in 2014
        ii. 6.5% increase in 20
    b. Estimated customer demand reduction of 2.1%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	23.5	24
2015	62.1	62
2016	62.4	62
2017	62.8	63
2018	63.1	63
2019	63.5	63
2020	63.8	64
2021	64.1	64
2022	64.5	64
2023	64.8	65
2024	65.1	65
2025	65.5	65
2026	65.8	66
2027	66.1	66
2028	66.5	66
2029	66.8	67
2030	67.1	67
2031	67.5	67
2032	67.8	68
2033	68.2	68
2034	68.5	69
2035	68.9	69
2036	69.2	69
2037	69.5	70
2038	69.9	70
2039	70.2	70
2040	70.6	71
2041	70.8	71
2042	71.1	71
2043	71.3	71
2044	71.5	72
2045	71.8	72
2046	72.0	72
2047	72.2	72
2048	72.5	72
2049	72.7	73
2050	72.9	73
2051	72.9	73
2052	72.9	73
2053	72.9	73
2054	72.9	73
2055	72.9	73
2056	72.9	73
2057	72.9	73
2058	72.9	73
2059	72.9	73
2060	72.9	73
2061	72.9	73
2062	72.9	73
2063	72.9	73
2064	72.9	73
2065	72.9	73
2066	72.9	73
2067	72.9	73
2068	72.9	73
2069	72.9	73
2070	72.9	73

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.00	0
2015	25,487	7.00	65
2016	25,190	7.00	64
2017	24,892	7.00	64
2018	24,595	7.00	63
2019	24,297	7.00	62
2020	24,000	7.00	61
2021	24,150	7.00	62
2022	24,300	7.00	62
2023	24,450	7.00	62
2024	24,600	7.00	63

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 62 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	62	64	127	62	22	9	31	158
2017	63	64	126	63	22	10	33	157
2018	63	63	126	63	27	12	39	150
2019	63	62	126	63	31	14	45	144
2020	64	61	125	64	40	15	56	133
2021	64	62	126	64	43	15	59	131
2022	64	62	127	64	46	15	61	130
2023	65	62	127	65	49	15	64	128
2024	65	63	128	65	52	15	67	126
2025	65	63	129	65	55	15	70	124
2026	66	64	129	66	58	15	73	122
2027	66	64	130	66	60	15	76	120
2028	66	64	131	66	63	15	79	119
2029	67	65	132	67	66	15	82	117
2030	67	65	132	67	69	15	84	115
2031	67	66	133	67	72	14	86	114
2032	68	66	134	68	75	12	88	114
2033	68	66	134	68	79	11	89	113
2034	69	67	135	69	82	9	91	113
2035	69	67	136	69	85	8	93	112
2036	69	67	137	69	88	6	94	112
2037	70	68	137	70	91	5	96	111
2038	70	68	138	70	94	3	97	111
2039	70	69	139	70	98	2	99	110
2040	71	69	140	71	101	0	101	109

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	62	64	127	40	22	9	31	136
2017	63	64	126	40	22	10	33	134
2018	63	63	126	40	27	12	39	127
2019	63	62	126	40	31	14	45	121
2020	64	61	125	41	40	15	56	110
2021	64	62	126	41	43	15	59	108
2022	64	62	127	41	46	15	61	106
2023	65	62	127	41	49	15	64	104
2024	65	63	128	42	52	15	67	102
2025	65	63	129	42	55	15	70	100
2026	66	64	129	42	58	15	73	98
2027	66	64	130	42	60	15	76	97
2028	66	64	131	42	63	15	79	95
2029	67	65	132	43	66	15	82	93
2030	67	65	132	43	69	15	84	91
2031	67	66	133	43	72	14	86	90
2032	68	66	134	43	75	12	88	89
2033	68	66	134	43	79	11	89	89
2034	69	67	135	44	82	9	91	88
2035	69	67	136	44	85	8	93	87
2036	69	67	137	44	88	6	94	87
2037	70	68	137	44	91	5	96	86
2038	70	68	138	45	94	3	97	85
2039	70	69	139	45	98	2	99	85
2040	71	69	140	45	101	0	101	84

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Copeville SUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Copeville SUD's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Copeville SUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Copeville SUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Copeville SUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(2.0)	(2.0)	0.1	0.3	0.4	(2.4)
2016	1.9	(2.0)	(0.0)	0.2	0.4	0.5	(0.6)
2017	4.0	(2.0)	2.0	0.2	0.4	0.6	1.3
2018	4.0	(2.0)	2.0	0.2	0.5	0.7	1.3
2019	4.1	(2.0)	2.1	0.3	0.6	0.8	1.2
2020	4.2	(2.0)	2.1	0.3	0.7	1.0	1.2
2021	4.3	(2.0)	2.2	0.4	0.7	1.0	1.2
2022	4.3	(2.0)	2.3	0.5	0.7	1.1	1.2
2023	4.4	(2.0)	2.4	0.5	0.7	1.2	1.2
2024	4.5	(2.1)	2.4	0.6	0.7	1.2	1.1
2025	4.6	(2.2)	2.4	0.7	0.7	1.3	1.1
2026	4.6	(2.2)	2.4	0.7	0.7	1.4	1.1
2027	4.7	(2.3)	2.4	0.8	0.7	1.4	1.0
2028	4.8	(2.3)	2.5	0.8	0.7	1.5	1.0
2029	4.9	(2.4)	2.5	0.9	0.7	1.6	0.9
2030	4.9	(2.4)	2.5	1.0	0.7	1.6	0.9
2031	5.0	(2.5)	2.6	1.0	0.6	1.6	0.9
2032	5.1	(2.5)	2.6	1.1	0.5	1.6	1.0
2033	5.2	(2.6)	2.7	1.2	0.5	1.6	1.0
2034	5.3	(2.6)	2.7	1.2	0.4	1.6	1.1
2035	5.4	(2.7)	2.7	1.3	0.3	1.6	1.1
2036	5.5	(2.7)	2.8	1.4	0.3	1.6	1.1
2037	5.6	(2.8)	2.8	1.4	0.2	1.6	1.2
2038	5.7	(2.9)	2.9	1.5	0.1	1.6	1.2
2039	5.8	(2.9)	2.9	1.6	0.1	1.6	1.3
2040	5.9	(3.0)	2.9	1.6	0.0	1.6	1.3
2041	6.1	(3.1)	3.1	1.7	0.0	1.7	1.3
2042	6.3	(3.1)	3.2	1.8	0.0	1.8	1.4
2043	6.5	(3.2)	3.3	1.9	0.0	1.9	1.4
2044	6.7	(3.3)	3.4	2.0	0.0	2.0	1.4
2045	6.9	(3.4)	3.5	2.1	0.0	2.1	1.3
2046	7.1	(3.5)	3.5	2.2	0.0	2.2	1.3
2047	7.2	(3.6)	3.6	2.3	0.0	2.3	1.3
2048	7.4	(3.7)	3.7	2.4	0.0	2.4	1.3
2049	7.6	(3.8)	3.8	2.5	0.0	2.5	1.3
2050	7.8	(3.9)	3.9	2.6	0.0	2.6	1.3
2051	8.4	(4.0)	4.3	2.9	0.0	2.9	1.4
2052	9.0	(4.2)	4.8	3.2	0.0	3.2	1.6
2053	9.5	(4.3)	5.3	3.5	0.0	3.5	1.8
2054	10.1	(4.6)	5.5	3.8	0.0	3.8	1.8
2055	10.7	(4.9)	5.8	4.1	0.0	4.1	1.7
2056	11.3	(5.2)	6.1	4.4	0.0	4.4	1.7
2057	11.9	(5.5)	6.3	4.7	0.0	4.7	1.7
2058	12.4	(5.9)	6.6	5.0	0.0	5.0	1.6
2059	13.0	(6.2)	6.8	5.2	0.0	5.2	1.6
2060	13.6	(6.5)	7.1	5.5	0.0	5.5	1.5
2061	14.6	(6.8)	7.7	6.1	0.0	6.1	1.6
2062	15.5	(7.1)	8.4	6.7	0.0	6.7	1.7
2063	16.5	(7.5)	9.0	7.3	0.0	7.3	1.7
2064	17.4	(8.0)	9.4	7.9	0.0	7.9	1.6
2065	18.4	(8.5)	9.9	8.5	0.0	8.5	1.4
2066	19.4	(9.1)	10.3	9.1	0.0	9.1	1.3
2067	20.3	(9.6)	10.7	9.6	0.0	9.6	1.1
2068	21.3	(10.1)	11.2	10.2	0.0	10.2	0.9
2069	22.3	(10.7)	11.6	10.8	0.0	10.8	0.8
2070	23.2	(11.2)	12.0	11.4	0.0	11.4	0.6

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Copeville SUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	75	0	0	0
1	2016	3,809	75	0.5	0	(0.5)
2	2017	3,818	74	1.1	2.0	0.9
3	2018	3,828	74	1.6	2.0	0.4
4	2019	3,837	73	2.1	2.1	(0.0)
5-year Goal	2020	3,846	73	2.7	2.1	(0.5)
6	2021	3,942	73	3.3	2.2	(1.1)
7	2022	4,038	72	4.0	2.3	(1.7)
8	2023	4,133	72	4.7	2.4	(2.3)
9	2024	4,229	71	5.4	2.4	(3.0)
10-year Goal	2025	4,325	71	6.1	2.4	(3.7)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Copeville SUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	7.54	0	0	0
1	2016	3,809	7.48	0.1	(2.0)	(2.1)
2	2017	3,818	7.42	0.2	(2.0)	(2.2)
3	2018	3,828	7.37	0.2	(2.0)	(2.3)
4	2019	3,837	7.31	0.3	(2.0)	(2.4)
5-year Goal	2020	3,846	7.25	0.4	(2.0)	(2.4)
6	2021	3,942	7.20	0.5	(2.0)	(2.5)
7	2022	4,038	7.15	0.6	(2.0)	(2.6)
8	2023	4,133	7.10	0.7	(2.0)	(2.7)
9	2024	4,229	7.05	0.8	(2.1)	(2.9)
10-year Goal	2025	4,325	7.00	0.9	(2.2)	(3.0)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10.1% increase in 2016
        ii. 10.0% increase in 2017
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012		0.0
2013		0.0
2014		0.0
2015		0.0
2016	1.9	1.9
2017	4.0	4.0
2018	4.0	4.0
2019	4.1	4.1
2020	4.2	4.2
2021	4.3	4.3
2022	4.3	4.3
2023	4.4	4.4
2024	4.5	4.5
2025	4.6	4.6
2026	4.6	4.6
2027	4.7	4.7
2028	4.8	4.8
2029	4.9	4.9
2030	4.9	4.9
2031	5.0	5.0
2032	5.1	5.1
2033	5.2	5.2
2034	5.3	5.3
2035	5.4	5.4
2036	5.5	5.5
2037	5.6	5.6
2038	5.7	5.7
2039	5.8	5.8
2040	5.9	5.9
2041	6.1	6.1
2042	6.3	6.3
2043	6.5	6.5
2044	6.7	6.7
2045	6.9	6.9
2046	7.1	7.1
2047	7.2	7.2
2048	7.4	7.4
2049	7.6	7.6
2050	7.8	7.8
2051	8.4	8.4
2052	9.0	9.0
2053	9.5	9.5
2054	10.1	10.1
2055	10.7	10.7
2056	11.3	11.3
2057	11.9	11.9
2058	12.4	12.4
2059	13.0	13.0
2060	13.6	13.6
2061	14.6	14.6
2062	15.5	15.5
2063	16.5	16.5
2064	17.4	17.4
2065	18.4	18.4
2066	19.4	19.4
2067	20.3	20.3
2068	21.3	21.3
2069	22.3	22.3
2070	23.2	23.2

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	7.54	0
2015	3,662	9.00	(2.0)
2016	3,708	9.00	(2.0)
2017	3,754	9.00	(2.0)
2018	3,800	9.00	(2.0)
2019	3,809	9.00	(2.0)
2020	3,818	9.00	(2.0)
2021	3,828	9.00	(2.0)
2022	3,837	9.00	(2.0)
2023	3,846	9.00	(2.0)
2024	3,942	9.00	(2.1)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 8 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	(2)	(0)	8	0	0	1	7
2017	4	(2)	2	8	0	0	1	9
2018	4	(2)	2	8	0	1	1	9
2019	4	(2)	2	8	0	1	1	9
2020	4	(2)	2	8	0	1	1	9
2021	4	(2)	2	8	0	1	1	10
2022	4	(2)	2	9	0	1	1	10
2023	4	(2)	2	9	1	1	1	10
2024	4	(2)	2	9	1	1	1	10
2025	5	(2)	2	9	1	1	1	10
2026	5	(2)	2	9	1	1	1	10
2027	5	(2)	2	9	1	1	1	10
2028	5	(2)	2	10	1	1	1	10
2029	5	(2)	2	10	1	1	2	11
2030	5	(2)	3	10	1	1	2	11
2031	5	(2)	3	10	1	1	2	11
2032	5	(3)	3	10	1	1	2	11
2033	5	(3)	3	10	1	0	2	11
2034	5	(3)	3	11	1	0	2	12
2035	5	(3)	3	11	1	0	2	12
2036	6	(3)	3	11	1	0	2	12
2037	6	(3)	3	11	1	0	2	12
2038	6	(3)	3	11	1	0	2	13
2039	6	(3)	3	12	2	0	2	13
2040	6	(3)	3	12	2	0	2	13

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	(2)	(0)	1	0	0	1	1
2017	4	(2)	2	1	0	0	1	3
2018	4	(2)	2	1	0	1	1	3
2019	4	(2)	2	1	0	1	1	3
2020	4	(2)	2	1	0	1	1	3
2021	4	(2)	2	1	0	1	1	3
2022	4	(2)	2	1	0	1	1	3
2023	4	(2)	2	1	1	1	1	3
2024	4	(2)	2	1	1	1	1	3
2025	5	(2)	2	2	1	1	1	3
2026	5	(2)	2	2	1	1	1	3
2027	5	(2)	2	2	1	1	1	3
2028	5	(2)	2	2	1	1	1	3
2029	5	(2)	2	2	1	1	2	3
2030	5	(2)	3	2	1	1	2	3
2031	5	(2)	3	2	1	1	2	3
2032	5	(3)	3	2	1	1	2	3
2033	5	(3)	3	2	1	0	2	3
2034	5	(3)	3	2	1	0	2	3
2035	5	(3)	3	2	1	0	2	3
2036	6	(3)	3	2	1	0	2	3
2037	6	(3)	3	2	1	0	2	3
2038	6	(3)	3	2	1	0	2	3
2039	6	(3)	3	2	2	0	2	3
2040	6	(3)	3	2	2	0	2	3

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Coppell Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Coppell's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Coppell's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Coppell's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Coppell with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	106	(90)	16	21	8	29	(13)
2016	106	(90)	16	26	10	36	(20)
2017	199	(90)	109	26	12	38	71
2018	200	(91)	109	31	14	45	64
2019	200	(91)	109	37	16	52	57
2020	201	(91)	110	47	18	65	45
2021	201	(91)	110	50	18	68	42
2022	202	(91)	110	54	18	71	39
2023	202	(92)	110	57	18	75	36
2024	202	(92)	110	60	18	78	32
2025	203	(92)	110	63	18	81	29
2026	203	(93)	111	67	18	84	26
2027	204	(93)	111	70	18	88	23
2028	204	(93)	111	73	18	91	20
2029	205	(94)	111	76	18	94	17
2030	205	(94)	111	80	18	97	14
2031	205	(94)	111	82	16	99	12
2032	205	(94)	111	85	14	100	11
2033	205	(94)	111	88	13	101	10
2034	205	(94)	110	91	11	102	8
2035	204	(94)	110	94	9	103	7
2036	204	(94)	110	97	7	104	6
2037	204	(94)	110	100	5	105	4
2038	204	(94)	110	103	4	107	3
2039	204	(94)	110	106	2	108	2
2040	203	(94)	109	109	0	109	1
2041	203	(94)	109	110	0	110	(1)
2042	203	(94)	109	111	0	111	(2)
2043	203	(94)	109	112	0	112	(3)
2044	203	(94)	109	113	0	113	(4)
2045	203	(94)	109	114	0	114	(6)
2046	203	(94)	109	116	0	116	(7)
2047	203	(94)	109	117	0	117	(8)
2048	203	(94)	109	118	0	118	(9)
2049	202	(94)	108	119	0	119	(10)
2050	202	(94)	108	120	0	120	(12)
2051	202	(94)	108	121	0	121	(13)
2052	202	(94)	108	122	0	122	(14)
2053	202	(94)	108	124	0	124	(15)
2054	202	(94)	108	125	0	125	(17)
2055	202	(94)	108	126	0	126	(18)
2056	202	(94)	108	127	0	127	(19)
2057	202	(94)	108	128	0	128	(20)
2058	202	(94)	108	130	0	130	(21)
2059	202	(94)	108	131	0	131	(23)
2060	202	(94)	108	132	0	132	(24)
2061	202	(94)	108	133	0	133	(25)
2062	202	(94)	108	134	0	134	(26)
2063	202	(94)	108	136	0	136	(28)
2064	202	(94)	108	137	0	137	(29)
2065	202	(94)	108	138	0	138	(30)
2066	202	(94)	108	139	0	139	(31)
2067	202	(94)	108	140	0	140	(32)
2068	202	(94)	108	142	0	142	(34)
2069	202	(94)	108	143	0	143	(35)
2070	202	(94)	108	144	0	144	(36)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Coppell's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	251	0	0	0
1	2016	41,219	243	117	16	(101)
2	2017	41,279	235	235	16	(219)
3	2018	41,340	228	353	109	(244)
4	2019	41,400	220	471	109	(362)
5-year Goal	2020	41,460	212	590	109	(481)
6	2021	41,609	212	598	110	(489)
7	2022	41,759	211	607	110	(497)
8	2023	41,908	211	615	110	(505)
9	2024	42,057	210	623	110	(513)
10-year Goal	2025	42,207	210	632	110	(521)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Coppell's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	13.00	0	0	0
1	2016	41,219	13.00	0	(90)	(90)
2	2017	41,279	13.00	0	(90)	(90)
3	2018	41,340	13.00	0	(91)	(91)
4	2019	41,400	13.00	0	(91)	(91)
5-year Goal	2020	41,460	13.00	0	(91)	(91)
6	2021	41,609	13.00	0	(91)	(91)
7	2022	41,759	13.00	0	(91)	(91)
8	2023	41,908	13.00	0	(92)	(92)
9	2024	42,057	13.00	0	(92)	(92)
10-year Goal	2025	42,207	13.00	0	(92)	(92)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 90 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 15% increase in 2015
        ii. 13% increase in 2017
    b. Estimated customer demand reduction of 5.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015	106.2	106
2016	106.5	106
2017	199.2	199
2018	199.7	200
2019	200.1	200
2020	200.6	201
2021	201.1	201
2022	201.5	202
2023	202.0	202
2024	202.5	202
2025	202.9	203
2026	203.4	203
2027	203.8	204
2028	204.3	204
2029	204.8	205
2030	205.2	205
2031	205.0	205
2032	204.9	205
2033	204.7	205
2034	204.5	205
2035	204.3	204
2036	204.1	204
2037	204.0	204
2038	203.8	204
2039	203.6	204
2040	203.4	203
2041	203.3	203
2042	203.2	203
2043	203.1	203
2044	203.0	203
2045	202.9	203
2046	202.8	203
2047	202.7	203
2048	202.6	203
2049	202.5	202
2050	202.4	202
2051	202.4	202
2052	202.3	202
2053	202.3	202
2054	202.3	202
2055	202.3	202
2056	202.2	202
2057	202.2	202
2058	202.2	202
2059	202.1	202
2060	202.1	202
2061	202.1	202
2062	202.1	202
2063	202.1	202
2064	202.1	202
2065	202.1	202
2066	202.1	202
2067	202.1	202
2068	202.1	202
2069	202.1	202
2070	202.1	202

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	13.00	0
2015	41,159	19.00	(90)
2016	41,219	19.00	(90)
2017	41,279	19.00	(90)
2018	41,340	19.00	(91)
2019	41,400	19.00	(91)
2020	41,460	19.00	(91)
2021	41,609	19.00	(91)
2022	41,759	19.00	(91)
2023	41,908	19.00	(92)
2024	42,057	19.00	(92)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region C savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 284 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	106	(90)	16	284	26	10	36	264
2017	199	(90)	109	285	26	12	38	355
2018	200	(91)	109	285	31	14	45	349
2019	200	(91)	109	286	37	16	52	343
2020	201	(91)	110	287	47	18	65	331
2021	201	(91)	110	287	50	18	68	329
2022	202	(91)	110	288	54	18	71	327
2023	202	(92)	110	289	57	18	75	324
2024	202	(92)	110	289	60	18	78	322
2025	203	(92)	110	290	63	18	81	319
2026	203	(93)	111	291	67	18	84	317
2027	204	(93)	111	291	70	18	88	314
2028	204	(93)	111	292	73	18	91	312
2029	205	(94)	111	293	76	18	94	309
2030	205	(94)	111	293	80	18	97	307
2031	205	(94)	111	293	82	16	99	305
2032	205	(94)	111	293	85	14	100	304
2033	205	(94)	111	292	88	13	101	302
2034	205	(94)	110	292	91	11	102	301
2035	204	(94)	110	292	94	9	103	299
2036	204	(94)	110	292	97	7	104	297
2037	204	(94)	110	291	100	5	105	296
2038	204	(94)	110	291	103	4	107	294
2039	204	(94)	110	291	106	2	108	293
2040	203	(94)	109	291	109	0	109	291

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	106	(90)	16	48	26	10	36	28
2017	199	(90)	109	48	26	12	38	118
2018	200	(91)	109	48	31	14	45	112
2019	200	(91)	109	48	37	16	52	105
2020	201	(91)	110	48	47	18	65	93
2021	201	(91)	110	48	50	18	68	90
2022	202	(91)	110	48	54	18	71	87
2023	202	(92)	110	48	57	18	75	84
2024	202	(92)	110	48	60	18	78	81
2025	203	(92)	110	49	63	18	81	78
2026	203	(93)	111	49	67	18	84	75
2027	204	(93)	111	49	70	18	88	72
2028	204	(93)	111	49	73	18	91	69
2029	205	(94)	111	49	76	18	94	66
2030	205	(94)	111	49	80	18	97	63
2031	205	(94)	111	49	82	16	99	61
2032	205	(94)	111	49	85	14	100	60
2033	205	(94)	111	49	88	13	101	59
2034	205	(94)	110	49	91	11	102	57
2035	204	(94)	110	49	94	9	103	56
2036	204	(94)	110	49	97	7	104	55
2037	204	(94)	110	49	100	5	105	53
2038	204	(94)	110	49	103	4	107	52
2039	204	(94)	110	49	106	2	108	51
2040	203	(94)	109	49	109	0	109	49

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Corinth Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Corinth's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Corinth's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Corinth's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Corinth with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.3	(38)	(38)	8	3	11	(49)
2016	0.3	(40)	(39)	10	4	14	(54)
2017	0.3	(41)	(41)	10	5	15	(56)
2018	0.3	(43)	(42)	12	5	18	(60)
2019	0.3	(44)	(44)	14	6	21	(64)
2020	0.2	(45)	(45)	19	7	25	(71)
2021	0.1	(46)	(46)	20	7	27	(73)
2022	0.1	(47)	(47)	22	7	29	(76)
2023	0	(48)	(48)	24	7	30	(78)
2024	0	(49)	(49)	25	7	32	(81)
2025	0	(50)	(50)	27	7	34	(83)
2026	0	(50)	(50)	29	7	35	(86)
2027	0	(51)	(51)	30	7	37	(88)
2028	0	(52)	(52)	32	7	39	(91)
2029	0	(53)	(53)	34	7	40	(93)
2030	0	(54)	(54)	35	7	42	(96)
2031	0	(54)	(54)	37	6	43	(97)
2032	0	(54)	(54)	38	5	43	(97)
2033	0	(54)	(54)	39	5	44	(98)
2034	0	(54)	(54)	41	4	45	(98)
2035	0	(54)	(54)	42	3	45	(99)
2036	0	(54)	(54)	43	3	46	(100)
2037	0	(54)	(54)	45	2	47	(100)
2038	0	(54)	(54)	46	1	47	(101)
2039	0	(54)	(54)	47	1	48	(102)
2040	0	(54)	(54)	49	0	49	(102)
2041	0	(54)	(54)	49	0	49	(103)
2042	0	(54)	(54)	50	0	50	(103)
2043	0	(54)	(54)	50	0	50	(104)
2044	0	(54)	(54)	51	0	51	(104)
2045	0	(54)	(54)	51	0	51	(105)
2046	0	(54)	(54)	52	0	52	(106)
2047	0	(54)	(54)	52	0	52	(106)
2048	0	(54)	(54)	53	0	53	(107)
2049	0	(54)	(54)	53	0	53	(107)
2050	0	(54)	(54)	54	0	54	(108)
2051	0	(54)	(54)	54	0	54	(108)
2052	0	(54)	(54)	55	0	55	(109)
2053	0	(54)	(54)	55	0	55	(109)
2054	0	(54)	(54)	56	0	56	(110)
2055	0	(54)	(54)	56	0	56	(110)
2056	0	(54)	(54)	57	0	57	(111)
2057	0	(54)	(54)	57	0	57	(111)
2058	0	(54)	(54)	58	0	58	(112)
2059	0	(54)	(54)	58	0	58	(112)
2060	0	(54)	(54)	59	0	59	(113)
2061	0	(54)	(54)	60	0	60	(113)
2062	0	(54)	(54)	60	0	60	(114)
2063	0	(54)	(54)	61	0	61	(114)
2064	0	(54)	(54)	61	0	61	(115)
2065	0	(54)	(54)	62	0	62	(116)
2066	0	(54)	(54)	62	0	62	(116)
2067	0	(54)	(54)	63	0	63	(117)
2068	0	(54)	(54)	63	0	63	(117)
2069	0	(54)	(54)	64	0	64	(118)
2070	0	(54)	(54)	65	0	65	(118)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Corinth's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	149	0	0	0
1	2017	22,563	147	15	(41)	(56)
2	2018	23,346	145	31	(42)	(73)
3	2019	24,128	144	48	(44)	(91)
4	2020	24,911	142	65	(45)	(111)
5-year Goal	2021	25,370	140	83	(46)	(130)
6	2022	25,829	139	96	(47)	(143)
7	2023	26,287	138	109	(48)	(157)
8	2024	26,746	136	123	(49)	(172)
9	2025	27,205	135	137	(50)	(187)
10-year Goal	2026	27,664	134	151	(50)	(202)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Corinth's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2017	22,563	8.60	3	(41)	(44)
2	2018	23,346	8.20	7	(43)	(49)
3	2019	24,128	7.80	11	(44)	(55)
4	2020	24,911	7.40	15	(45)	(60)
5-year Goal	2021	25,370	7.00	19	(46)	(65)
6	2022	25,829	6.60	23	(47)	(70)
7	2023	26,287	6.20	27	(48)	(75)
8	2024	26,746	5.80	31	(49)	(80)
9	2025	27,205	5.40	36	(50)	(85)
10-year Goal	2026	27,664	5.00	40	(50)	(91)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Loss of 38 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Outdoor landscape evaluations for single family (SF) customers**
   a. 96 outdoor evaluations performed or projected to perform since 2016
   b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
      i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
   c. Approximately 22 gallons per day

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

d. Greater savings during peak periods
e. Lesser savings during off-peak periods
b. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Outdoor Water Audits	TOTAL SAVINGS
2012	0.1	0.1
2013	0.2	0.2
2014	0.2	0.2
2015	0.3	0.3
2016	0.3	0.3
2017	0.3	0.3
2018	0.3	0.3
2019	0.3	0.3
2020	0.2	0.2
2021	0.1	0.1
2022	0.1	0.1
2023	0.02	0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	20,998	14.00	(38)
2016	21,781	14.00	(40)
2017	22,563	14.00	(41)
2018	23,346	14.00	(43)
2019	24,128	14.00	(44)
2020	24,911	14.00	(45)
2021	25,370	14.00	(46)
2022	25,829	14.00	(47)
2023	26,287	14.00	(48)
2024	26,746	14.00	(49)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 9.89% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 128 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(40)	(39)	128	10	4	14	75
2017	0	(41)	(41)	131	10	5	15	75
2018	0	(43)	(42)	133	12	5	18	73
2019	0	(44)	(44)	135	14	6	21	71
2020	0	(45)	(45)	137	19	7	25	67
2021	0	(46)	(46)	140	20	7	27	67
2022	0	(47)	(47)	142	22	7	29	66
2023	0	(48)	(48)	144	24	7	30	66
2024	0	(49)	(49)	147	25	7	32	66
2025	0	(50)	(50)	149	27	7	34	66
2026	0	(50)	(50)	151	29	7	35	65
2027	0	(51)	(51)	154	30	7	37	65
2028	0	(52)	(52)	156	32	7	39	65
2029	0	(53)	(53)	158	34	7	40	65
2030	0	(54)	(54)	161	35	7	42	65
2031	0	(54)	(54)	161	37	6	43	64
2032	0	(54)	(54)	160	38	5	43	63
2033	0	(54)	(54)	160	39	5	44	63
2034	0	(54)	(54)	160	41	4	45	62
2035	0	(54)	(54)	160	42	3	45	61
2036	0	(54)	(54)	160	43	3	46	60
2037	0	(54)	(54)	160	45	2	47	60
2038	0	(54)	(54)	160	46	1	47	59
2039	0	(54)	(54)	160	47	1	48	58
2040	0	(54)	(54)	160	49	0	49	57

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(40)	(39)	17	10	4	14	(36)
2017	0	(41)	(41)	18	10	5	15	(38)
2018	0	(43)	(42)	18	12	5	18	(42)
2019	0	(44)	(44)	18	14	6	21	(46)
2020	0	(45)	(45)	19	19	7	25	(52)
2021	0	(46)	(46)	19	20	7	27	(54)
2022	0	(47)	(47)	19	22	7	29	(57)
2023	0	(48)	(48)	20	24	7	30	(59)
2024	0	(49)	(49)	20	25	7	32	(61)
2025	0	(50)	(50)	20	27	7	34	(63)
2026	0	(50)	(50)	21	29	7	35	(65)
2027	0	(51)	(51)	21	30	7	37	(68)
2028	0	(52)	(52)	21	32	7	39	(70)
2029	0	(53)	(53)	21	34	7	40	(72)
2030	0	(54)	(54)	22	35	7	42	(74)
2031	0	(54)	(54)	22	37	6	43	(75)
2032	0	(54)	(54)	22	38	5	43	(75)
2033	0	(54)	(54)	22	39	5	44	(76)
2034	0	(54)	(54)	22	41	4	45	(77)
2035	0	(54)	(54)	22	42	3	45	(77)
2036	0	(54)	(54)	22	43	3	46	(78)
2037	0	(54)	(54)	22	45	2	47	(79)
2038	0	(54)	(54)	22	46	1	47	(79)
2039	0	(54)	(54)	22	47	1	48	(80)
2040	0	(54)	(54)	22	49	0	49	(81)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 26 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(40)	(39)	26	10	4	14	(28)
2017	0	(41)	(41)	26	10	5	15	(29)
2018	0	(43)	(42)	27	12	5	18	(33)
2019	0	(44)	(44)	27	14	6	21	(37)
2020	0	(45)	(45)	28	19	7	25	(43)
2021	0	(46)	(46)	28	20	7	27	(45)
2022	0	(47)	(47)	29	22	7	29	(47)
2023	0	(48)	(48)	29	24	7	30	(49)
2024	0	(49)	(49)	30	25	7	32	(51)
2025	0	(50)	(50)	30	27	7	34	(53)
2026	0	(50)	(50)	31	29	7	35	(55)
2027	0	(51)	(51)	31	30	7	37	(57)
2028	0	(52)	(52)	32	32	7	39	(59)
2029	0	(53)	(53)	32	34	7	40	(61)
2030	0	(54)	(54)	32	35	7	42	(63)
2031	0	(54)	(54)	32	37	6	43	(64)
2032	0	(54)	(54)	32	38	5	43	(65)
2033	0	(54)	(54)	32	39	5	44	(65)
2034	0	(54)	(54)	32	41	4	45	(66)
2035	0	(54)	(54)	32	42	3	45	(67)
2036	0	(54)	(54)	32	43	3	46	(67)
2037	0	(54)	(54)	32	45	2	47	(68)
2038	0	(54)	(54)	32	46	1	47	(69)
2039	0	(54)	(54)	32	47	1	48	(69)
2040	0	(54)	(54)	32	49	0	49	(70)

4. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Corsicana Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Corsicana's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Corsicana's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Corsicana's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Corsicana with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	44	44	12	4	16	28
2016	0	45	45	14	5	20	25
2017	0	45	45	14	7	21	24
2018	0	46	46	17	8	25	21
2019	0	47	47	20	9	29	18
2020	0	48	48	26	10	36	12
2021	0	48	48	28	10	38	11
2022	0	49	49	30	10	40	9
2023	0	49	49	32	10	42	8
2024	0	50	50	34	10	44	6
2025	0	50	50	36	10	46	5
2026	0	51	51	38	10	48	3
2027	0	51	51	40	10	50	2
2028	0	52	52	42	10	51	0
2029	0	52	52	44	10	53	(1)
2030	0	53	53	46	10	55	(2)
2031	0	53	53	48	9	57	(3)
2032	0	54	54	50	8	58	(4)
2033	0	54	54	52	7	59	(5)
2034	0	55	55	55	6	61	(6)
2035	0	55	55	57	5	62	(6)
2036	0	56	56	59	4	63	(7)
2037	0	56	56	62	3	65	(8)
2038	0	57	57	64	2	66	(9)
2039	0	57	57	66	1	67	(10)
2040	0	58	58	68	0	68	(10)
2041	0	59	59	70	0	70	(11)
2042	0	59	59	71	0	71	(12)
2043	0	60	60	73	0	73	(13)
2044	0	60	60	74	0	74	(14)
2045	0	61	61	76	0	76	(15)
2046	0	61	61	77	0	77	(16)
2047	0	62	62	78	0	78	(16)
2048	0	63	63	80	0	80	(17)
2049	0	63	63	81	0	81	(18)
2050	0	64	64	83	0	83	(19)
2051	0	64	64	84	0	84	(20)
2052	0	65	65	86	0	86	(21)
2053	0	66	66	88	0	88	(22)
2054	0	66	66	90	0	90	(23)
2055	0	67	67	91	0	91	(24)
2056	0	67	67	93	0	93	(26)
2057	0	68	68	95	0	95	(27)
2058	0	69	69	96	0	96	(28)
2059	0	69	69	98	0	98	(29)
2060	0	70	70	100	0	100	(30)
2061	0	71	71	102	0	102	(31)
2062	0	71	71	104	0	104	(32)
2063	0	72	72	105	0	105	(34)
2064	0	72	72	107	0	107	(35)
2065	0	73	73	109	0	109	(36)
2066	0	74	74	111	0	111	(37)
2067	0	74	74	113	0	113	(39)
2068	0	75	75	115	0	115	(40)
2069	0	76	76	117	0	117	(41)
2070	0	76	76	119	0	119	(42)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Corsicana's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	151	0	0	0
1	2015	23,989	152	(5)	44	49
2	2016	24,451	152	(11)	45	55
3	2017	24,913	153	(16)	45	62
4	2018	25,374	153	(22)	46	69
5-year Goal	2019	25,836	154	(28)	47	75
6	2020	26,298	153	(15)	48	63
7	2021	26,568	151	(2)	48	50
8	2022	26,838	150	12	49	37
9	2023	27,108	148	26	49	24
10-year Goal	2024	27,378	147	40	50	10

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Corsicana's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	31.00	0	0	0
1	2015	23,989	27.60	30	44	14
2	2016	24,451	24.20	61	45	(16)
3	2017	24,913	20.80	93	45	(47)
4	2018	25,374	17.40	126	46	(80)
5-year Goal	2019	25,836	14.00	160	47	(113)
6	2020	26,298	13.20	171	48	(123)
7	2021	26,568	12.40	180	48	(132)
8	2022	26,838	11.60	190	49	(141)
9	2023	27,108	10.80	200	49	(150)
10-year Goal	2024	27,378	10.00	210	50	(160)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 44 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	31.00	0
2015	23,989	26.00	44
2016	24,451	26.00	45
2017	24,913	26.00	45
2018	25,374	26.00	46
2019	25,836	26.00	47
2020	26,298	26.00	48
2021	26,568	26.00	48
2022	26,838	26.00	49
2023	27,108	26.00	49
2024	27,378	26.00	50

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 9.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 171 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	45	45	171	14	5	20	196
2017	0	45	45	173	14	7	21	197
2018	0	46	46	174	17	8	25	196
2019	0	47	47	176	20	9	29	194
2020	0	48	48	177	26	10	36	189
2021	0	48	48	178	28	10	38	189
2022	0	49	49	180	30	10	40	189
2023	0	49	49	181	32	10	42	189
2024	0	50	50	183	34	10	44	189
2025	0	50	50	184	36	10	46	189
2026	0	51	51	185	38	10	48	189
2027	0	51	51	187	40	10	50	189
2028	0	52	52	188	42	10	51	189
2029	0	52	52	190	44	10	53	189
2030	0	53	53	191	46	10	55	188
2031	0	53	53	192	48	9	57	189
2032	0	54	54	194	50	8	58	190
2033	0	54	54	195	52	7	59	191
2034	0	55	55	197	55	6	61	191
2035	0	55	55	198	57	5	62	192
2036	0	56	56	200	59	4	63	193
2037	0	56	56	201	62	3	65	193
2038	0	57	57	203	64	2	66	194
2039	0	57	57	204	66	1	67	195
2040	0	58	58	206	68	0	68	196

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

   a. Specific utility results will vary based on portal features and frequency of customer notifications
   b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
   c. Estimate assumes customers will save 10% of total annual use due to the portal

i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

i. This was the most common percentage of residential use among participating utilities in this project.

ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	45	45	25	14	5	20	50
2017	0	45	45	26	14	7	21	50
2018	0	46	46	26	17	8	25	47
2019	0	47	47	26	20	9	29	44
2020	0	48	48	26	26	10	36	38
2021	0	48	48	26	28	10	38	37
2022	0	49	49	27	30	10	40	36
2023	0	49	49	27	32	10	42	35
2024	0	50	50	27	34	10	44	33
2025	0	50	50	27	36	10	46	32
2026	0	51	51	27	38	10	48	31
2027	0	51	51	28	40	10	50	30
2028	0	52	52	28	42	10	51	28
2029	0	52	52	28	44	10	53	27
2030	0	53	53	28	46	10	55	26
2031	0	53	53	28	48	9	57	25
2032	0	54	54	29	50	8	58	25
2033	0	54	54	29	52	7	59	24
2034	0	55	55	29	55	6	61	24
2035	0	55	55	29	57	5	62	23
2036	0	56	56	30	59	4	63	22
2037	0	56	56	30	62	3	65	22
2038	0	57	57	30	64	2	66	21
2039	0	57	57	30	66	1	67	21
2040	0	58	58	30	68	0	68	20

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 38 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	45	45	38	14	5	20	63
2017	0	45	45	38	14	7	21	63
2018	0	46	46	39	17	8	25	60
2019	0	47	47	39	20	9	29	57
2020	0	48	48	39	26	10	36	51
2021	0	48	48	39	28	10	38	50
2022	0	49	49	40	30	10	40	49
2023	0	49	49	40	32	10	42	48
2024	0	50	50	40	34	10	44	47
2025	0	50	50	41	36	10	46	45
2026	0	51	51	41	38	10	48	44
2027	0	51	51	41	40	10	50	43
2028	0	52	52	42	42	10	51	42
2029	0	52	52	42	44	10	53	41
2030	0	53	53	42	46	10	55	40
2031	0	53	53	43	48	9	57	39
2032	0	54	54	43	50	8	58	39
2033	0	54	54	43	52	7	59	38
2034	0	55	55	44	55	6	61	38
2035	0	55	55	44	57	5	62	37
2036	0	56	56	44	59	4	63	37
2037	0	56	56	45	62	3	65	36
2038	0	57	57	45	64	2	66	36
2039	0	57	57	45	66	1	67	36
2040	0	58	58	46	68	0	68	35

4. Rain Barrel
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Crowley Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Crowley's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Crowley's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Crowley's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Crowley with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	59	(36)	23	1	2	3	20
2016	60	(37)	23	1	2	4	20
2017	61	(37)	23	1	3	4	19
2018	61	(38)	23	2	3	5	19
2019	62	(39)	24	2	3	6	18
2020	63	(39)	24	3	4	7	17
2021	64	(40)	24	3	4	7	17
2022	65	(41)	24	3	4	7	17
2023	66	(41)	25	4	4	7	17
2024	67	(42)	25	4	4	8	17
2025	68	(43)	25	4	4	8	17
2026	69	(43)	25	5	4	8	17
2027	70	(44)	26	5	4	9	17
2028	71	(45)	26	5	4	9	17
2029	71	(45)	26	6	4	9	17
2030	72	(46)	26	6	4	10	16
2031	74	(47)	27	6	4	10	17
2032	75	(48)	27	7	3	10	17
2033	76	(49)	27	7	3	10	17
2034	78	(50)	28	8	2	10	18
2035	79	(51)	28	8	2	10	18
2036	80	(52)	29	9	2	10	18
2037	81	(52)	29	9	1	10	19
2038	83	(53)	29	10	1	11	19
2039	84	(54)	30	10	0	11	19
2040	85	(55)	30	11	0	11	19
2041	87	(56)	31	11	0	11	19
2042	89	(57)	31	12	0	12	19
2043	90	(58)	32	13	0	13	19
2044	92	(60)	32	13	0	13	19
2045	94	(61)	33	14	0	14	19
2046	95	(62)	33	14	0	14	19
2047	97	(63)	34	15	0	15	19
2048	99	(64)	35	16	0	16	19
2049	100	(65)	35	16	0	16	19
2050	102	(66)	36	17	0	17	19
2051	105	(68)	37	18	0	18	19
2052	108	(70)	38	19	0	19	19
2053	110	(72)	39	20	0	20	19
2054	113	(74)	40	21	0	21	19
2055	116	(76)	40	22	0	22	18
2056	119	(77)	41	23	0	23	18
2057	122	(79)	42	24	0	24	18
2058	125	(81)	43	25	0	25	18
2059	127	(83)	44	26	0	26	18
2060	130	(85)	45	27	0	27	18
2061	132	(86)	46	28	0	28	18
2062	134	(87)	47	29	0	29	18
2063	136	(88)	47	30	0	30	17
2064	138	(90)	48	31	0	31	17
2065	139	(91)	49	32	0	32	17
2066	141	(92)	49	33	0	33	16
2067	143	(93)	50	34	0	34	16
2068	145	(95)	50	35	0	35	16
2069	147	(96)	51	36	0	36	15
2070	149	(97)	52	37	0	37	15

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Crowley's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	126	0	0	0
1	2016	15,155	121	29	23	(6)
2	2017	15,457	116	59	23	(35)
3	2018	15,758	110	90	23	(66)
4	2019	16,060	105	122	24	(98)
5-year Goal	2020	16,362	100	155	24	(131)
6	2021	16,640	98	173	24	(149)
7	2022	16,918	95	191	24	(167)
8	2023	17,196	93	210	25	(186)
9	2024	17,474	90	230	25	(205)
10-year Goal	2025	17,752	88	249	25	(224)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Crowley's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	8.00	0	0	0
1	2016	15,155	7.40	3	(37)	(40)
2	2017	15,457	6.80	7	(37)	(44)
3	2018	15,758	6.20	10	(38)	(48)
4	2019	16,060	5.60	14	(39)	(53)
5-year Goal	2020	16,362	5.00	18	(39)	(57)
6	2021	16,640	4.80	19	(40)	(60)
7	2022	16,918	4.60	21	(41)	(62)
8	2023	17,196	4.40	23	(41)	(64)
9	2024	17,474	4.20	24	(42)	(66)
10-year Goal	2025	17,752	4.00	26	(43)	(69)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Loss of 36 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
   a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
   b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	TOTAL SAVINGS
2012		0
2013		0
2014	57.8	58
2015	58.7	59
2016	59.6	60
2017	60.5	61
2018	61.5	61
2019	62.4	62
2020	63.3	63
2021	64.2	64
2022	65.1	65
2023	66.0	66
2024	66.9	67
2025	67.8	68
2026	68.7	69
2027	69.6	70
2028	70.6	71
2029	71.5	71
2030	72.4	72
2031	73.7	74
2032	75.0	75
2033	76.3	76
2034	77.6	78
2035	78.9	79
2036	80.2	80
2037	81.4	81
2038	82.7	83
2039	84.0	84
2040	85.3	85
2041	87.0	87
2042	88.7	89
2043	90.3	90
2044	92.0	92
2045	93.7	94
2046	95.3	95
2047	97.0	97
2048	98.6	99
2049	100.3	100
2050	102.0	102
2051	104.8	105
2052	107.6	108
2053	110.4	110
2054	113.2	113
2055	116.1	116
2056	118.9	119
2057	121.7	122
2058	124.5	125
2059	127.3	127
2060	130.2	130
2061	132.0	132
2062	133.9	134
2063	135.7	136
2064	137.6	138
2065	139.4	139
2066	141.3	141
2067	143.1	143
2068	145.0	145
2069	146.8	147
2070	148.7	149

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	6.40	0
2015	14,853	13.00	(36)
2016	15,155	13.00	(37)
2017	15,457	13.00	(37)
2018	15,758	13.00	(38)
2019	16,060	13.00	(39)
2020	16,362	13.00	(39)
2021	16,640	13.00	(40)
2022	16,918	13.00	(41)
2023	17,196	13.00	(41)
2024	17,474	13.00	(42)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	59	(37)	22	10	1	2	4	29
2017	60	(37)	22	10	1	3	4	28
2018	61	(38)	23	10	2	3	5	28
2019	61	(39)	23	10	2	3	6	28
2020	62	(39)	23	11	3	4	7	27
2021	63	(40)	23	11	3	4	7	27
2022	64	(41)	23	11	3	4	7	27
2023	65	(41)	24	11	4	4	7	27
2024	66	(42)	24	11	4	4	8	27
2025	67	(43)	24	11	4	4	8	27
2026	68	(43)	24	12	5	4	8	27
2027	69	(44)	25	12	5	4	9	27
2028	70	(45)	25	12	5	4	9	28
2029	71	(45)	25	12	6	4	9	28
2030	71	(46)	25	12	6	4	10	28
2031	72	(47)	25	12	6	4	10	28
2032	74	(48)	26	13	7	3	10	28
2033	75	(49)	26	13	7	3	10	29
2034	76	(50)	27	13	8	2	10	29
2035	78	(51)	27	13	8	2	10	30
2036	79	(52)	27	13	9	2	10	30
2037	80	(52)	28	14	9	1	10	31
2038	81	(53)	28	14	10	1	11	31
2039	83	(54)	29	14	10	0	11	32
2040	84	(55)	29	14	11	0	11	32

2. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 15 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	59	(37)	22	15	1	2	4	34
2017	60	(37)	22	15	1	3	4	33
2018	61	(38)	23	15	2	3	5	33
2019	61	(39)	23	16	2	3	6	33
2020	62	(39)	23	16	3	4	7	32
2021	63	(40)	23	16	3	4	7	32
2022	64	(41)	23	16	3	4	7	33
2023	65	(41)	24	17	4	4	7	33
2024	66	(42)	24	17	4	4	8	33
2025	67	(43)	24	17	4	4	8	33
2026	68	(43)	24	17	5	4	8	33
2027	69	(44)	25	17	5	4	9	33
2028	70	(45)	25	18	5	4	9	33
2029	71	(45)	25	18	6	4	9	34
2030	71	(46)	25	18	6	4	10	34
2031	72	(47)	25	18	6	4	10	34
2032	74	(48)	26	19	7	3	10	35
2033	75	(49)	26	19	7	3	10	35
2034	76	(50)	27	19	8	2	10	36
2035	78	(51)	27	20	8	2	10	36
2036	79	(52)	27	20	9	2	10	37
2037	80	(52)	28	20	9	1	10	38
2038	81	(53)	28	21	10	1	11	38
2039	83	(54)	29	21	10	0	11	39
2040	84	(55)	29	21	11	0	11	39

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
DWU – City of Dallas Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal conservation terminology and review of methodology used by regional planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association
- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional planning group approach to determining supply volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, as much relevant data as possible was collected from participant utilities. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Each utility's conservation activities were then quantified through several different means, including evidence-based studies, utility-provided results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Dallas's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Dallas's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The five- and 10-year goals in Dallas's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

This report also contains additional tables not included in other individual reports that project Dallas's conservation activities according to feedback received from utility staff. To be consistent with the rest of the project, only utility savings for activities implemented through 2016 are included in Tables 3-1 through 3-3. For details on savings estimates from projected activities, see Sections 6 and 7 in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures we have carried forward in our model because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. Our approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current savings compared to conservation WMS supply volume (in million gallons) in regional water plan

Table 3-1 shows the 2070 planning period for Dallas with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

---

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. Because the regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, we have quantified utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current savings compared to conservation WMS supply volume (MG) in regional water plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	8,301	0	8,301	1,367	199	1,567	6,734
2016	10,579	0	10,579	1,709	249	1,958	8,621
2017	10,582	0	10,582	1,709	299	2,008	8,574
2018	10,606	0	10,606	2,051	349	2,400	8,206
2019	10,641	0	10,641	2,393	399	2,792	7,850
2020	10,684	0	10,684	3,077	448	3,525	7,159
2021	10,733	0	10,733	3,575	448	4,023	6,710
2022	10,792	0	10,792	4,073	448	4,521	6,271
2023	10,740	0	10,740	4,571	448	5,019	5,721
2024	10,687	0	10,687	5,068	448	5,517	5,170
2025	10,634	0	10,634	5,566	448	6,015	4,619
2026	10,582	0	10,582	6,064	448	6,513	4,069
2027	10,641	0	10,641	6,562	448	7,011	3,630
2028	10,701	0	10,701	7,060	448	7,509	3,192
2029	10,760	0	10,760	7,558	448	8,006	2,753
2030	10,819	0	10,819	8,056	448	8,504	2,315
2031	10,939	0	10,939	8,471	0	8,471	2,468
2032	11,060	0	11,060	8,886	0	8,886	2,174
2033	11,180	0	11,180	9,301	0	9,301	1,878
2034	11,299	0	11,299	9,716	0	9,716	1,583
2035	11,420	0	11,420	10,131	0	10,131	1,289
2036	11,540	0	11,540	10,547	0	10,547	993
2037	11,659	0	11,659	10,962	0	10,962	698
2038	11,780	0	11,780	11,377	0	11,377	403
2039	11,900	0	11,900	11,792	0	11,792	108
2040	12,019	0	12,019	12,207	0	12,207	(187)
2041	12,140	0	12,140	12,351	0	12,351	(211)
2042	12,260	0	12,260	12,495	0	12,495	(235)
2043	12,381	0	12,381	12,639	0	12,639	(258)
2044	12,501	0	12,501	12,783	0	12,783	(282)
2045	12,622	0	12,622	12,927	0	12,927	(305)
2046	12,742	0	12,742	13,071	0	13,071	(329)
2047	12,862	0	12,862	13,215	0	13,215	(354)
2048	12,983	0	12,983	13,359	0	13,359	(377)
2049	13,102	0	13,102	13,503	0	13,503	(401)
2050	13,223	0	13,223	13,647	0	13,647	(424)
2051	13,320	0	13,320	13,671	0	13,671	(352)
2052	13,416	0	13,416	13,695	0	13,695	(279)
2053	13,513	0	13,513	13,719	0	13,719	(206)
2054	13,609	0	13,609	13,743	0	13,743	(134)
2055	13,706	0	13,706	13,767	0	13,767	(60)
2056	13,802	0	13,802	13,791	0	13,791	12
2057	13,899	0	13,899	13,814	0	13,814	84
2058	13,996	0	13,996	13,838	0	13,838	158
2059	14,092	0	14,092	13,862	0	13,862	230
2060	14,189	0	14,189	13,886	0	13,886	303
2061	14,236	0	14,236	13,867	0	13,867	370
2062	14,284	0	14,284	13,848	0	13,848	436
2063	14,331	0	14,331	13,828	0	13,828	502
2064	14,377	0	14,377	13,809	0	13,809	568
2065	14,424	0	14,424	13,790	0	13,790	634
2066	14,471	0	14,471	13,771	0	13,771	700
2067	14,519	0	14,519	13,752	0	13,752	767
2068	14,566	0	14,566	13,733	0	13,733	833
2069	14,613	0	14,613	13,713	0	13,713	899
2070	14,660	0	14,660	13,694	0	13,694	966

3.2 Utility water conservation plan goals – total GPCD

Table 3-2 shows how Dallas's quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.[12]

Total GPCD Goals – Total GPCD goals start with the utility's baseline for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Section 6 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility water conservation plan goals — total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	204	0	0	0
1	2015	1,244,270	202	727	8,301	7,574
2	2016	1,257,730	201	1,469	10,579	9,110
3	2017	1,270,170	199	2,225	10,582	8,356
4	2018	1,283,120	198	2,997	10,606	7,608
5-year Goal	2019	1,296,070	196	3,785	10,641	6,857
6	2020	1,309,020	196	3,918	10,684	6,766
7	2021	1,321,970	196	4,053	10,733	6,680
8	2022	1,334,920	195	4,190	10,792	6,602
9	2023	1,347,870	195	4,329	10,740	6,411
10-year Goal	2024	1,360,820	195	4,470	10,687	6,216

[12] Population estimates through 2017 were gathered from North Central Texas Council of Governments public data. Estimates for years 2018 through 2024 were calculated by taking an average of growth rates from 2015 through 2017 (12,950 people per year).

3.3 Utility water conservation plan goals – water loss GPCD

Table 3-3 shows how Dallas's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated. [13]

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility water conservation plan goals — water loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	29.00	0	0	0
1	2015	1,244,270	28.80	91	0	(91)
2	2016	1,257,730	28.60	184	0	(184)
3	2017	1,270,170	28.40	278	0	(278)
4	2018	1,283,120	28.20	375	0	(375)
5-year Goal	2019	1,296,070	28.00	473	0	(473)
6	2020	1,309,020	27.80	573	0	(573)
7	2021	1,321,970	27.60	676	0	(676)
8	2022	1,334,920	27.40	780	0	(780)
9	2023	1,347,870	27.20	886	0	(886)
10-year Goal	2024	1,360,820	27.00	993	0	(993)

[13] Population estimates through 2017 were gathered from North Central Texas Council of Governments public data. Estimates for years 2018 through 2024 were calculated by taking an average of growth rates from 2015 through 2017 (12,950 people per year).

4 Implemented activities through 2016

Below is a list of *completed* activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. For the year 2016, this report used an average savings estimate from previous years' savings results. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water rate increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized activities

1. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 8 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

2. **Twice-per-week (or less) Outdoor Watering Ordinance**
    a. Estimated savings of 8.42% of total utility demand while ordinance in place (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

3. **Water Rate Increases**
    a. Major rate increase from 2013 – 2016:[14]
        i. 11.125% combined base rate increase
        ii. 11.425% combined volumetric rate increase
        iii. 11.275% overall increase with 50/50 weight given to base and volumetric rate increases = 2.255% of total demand
    b. Savings are cumulative and based on TWDB's Best Management Practices for Municipal Water Users Guide[15] (Texas Water Development Board, 2013), as well as Environmental Protection Agency guidelines and other sources (U.S. EPA, 1998; Whitcomb, 1999)

4. **Free Irrigation Inspections (SF/MF/C)**
    a. More than 5,700 inspections since program inception
    b. Savings estimates per year since 2009 were provided by utility (City of Dallas Water Utilities, 2016)
    c. For 2016, assumed an average of 844 audits and annual savings of 61,966 gallons per year per audit based on past savings figures provided by utility (City of Dallas Water Utilities, 2016)
    d. 20% decay rate per year attributed to customer behavior for similar programs (A&N Technical Services, 2005)

---

[14] Gathered from rates listed in 2013 and in 2016 from documents collected from staff.

[15] Water Conservation Advisory Council (WCAC) estimates 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

5. **Free Water Efficiency Surveys (ICI)**
    a. More than 320 surveys conducted from 2013 – 2015 (City of Dallas Water Utilities, 2016)
    b. Estimated 107 surveys completed annually
    c. Estimated savings of 1.049 MG per year per audit
    d. Approximately 112.3 MG stand alone peak annual savings, which amounts to 337 accumulated savings across three years (2013 – 2015)
    e. Because some measures implemented during the surveys included equipment, fixtures, and other hardware, assumed a 10-year useful life for savings with no decay rate to be conservative
        i. Savings could persist longer for some hardware items, while behavioral measures could mean savings decay at a faster rate

6. **City-owned Facilities Retrofit**
    a. From 2010 – 2015, estimated accumulated savings of 2.56 MG annually (City of Dallas Water Utilities, 2016)
    b. Estimated average savings of 426,667 gallons per year
    c. Savings assumed to be permanent as retrofitted fixtures will be replaced by equally as efficient fixtures when useful life ends

7. **New Throne for Your Home Program (SF)**
    a. More than 91,000 toilets replaced from 2007 – 2015 (City of Dallas Water Utilities, 2016)
    b. Average of 10,111 toilets replaced each year
    c. Estimated savings of 4,307.7 gallons per year per toilet
    d. Savings assumed to be permanent because toilets will be replaced by equally as efficient toilets due to current plumbing code and efficiency standards

8. **Minor Plumbing Repair Program**
    a. 3,770 families have participated from 2007 – 2015 (City of Dallas Water Utilities, 2016)
    b. Average of 419 households per year
    c. Estimated savings of 6,894.7 gallons per year per household
    d. 2.88 MG stand alone annual savings that accumulates to 26 MG of savings across 9 years of program implementation
    e. Savings assumed to be permanent because fixtures will be replaced by equally as efficient fixtures due to current plumbing code and efficiency standards

9. **Save Water Co. Program**
    a. Project initiated in Dallas's service area in 2015
    b. Save Water Co. completed work on 3,720 multi-family units from 2015 – 2016.
    c. Through personal communication, vendor indicated DWU rebates were occasionally used if the customer qualified, but that many customers that were served did not qualify.

    i. For savings associated with customers that did use DWU rebates, there is a possibility for competitive savings being quantified, or “double counting”

d. These third-party savings are included because the project attempted to capture as much quantifiable savings occurring within a utility’s service area as possible to compare to supply volumes
    i. This particular vendor does a high volume of work in the City of Dallas, so it was deemed reasonable to include its efforts.
e. Average monthly savings of 14.938 MG
f. Annualized savings of 176.26 MG for the life of the retrofitted fixtures
g. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
h. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
i. In Region C, the company’s work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.
j. Savings not projected for work that may be completed in the future

5 Summary of savings (implemented through 2016)

Table 5-1. Savings from all activities through 2016 not including water loss reduction (MG).

Year	2x Watering Ordinance	Water Rate Increases	Free Irrigation Inspections (SF/MF/C)	Free Water Efficiency Surveys (ICI)	City-owned Facilities Retrofit	New Throne for Your Home (Residential)	Minor Plumbing Repair Program	Save Water Co.	TOTAL SAVINGS
2009			38.6			130.7	9		178
2010			66.5		0.4	174.2	12		253
2011			101.6		0.9	217.8	14		335
2012	7,179		177.9		1.3	261.3	17		7,637
2013	7,226		190.6	112.3	1.7	304.9	20		7,856
2014	7,273		173.3	224.7	2.1	348.4	23		8,044
2015	7,320		146.7	337.0	2.6	392.0	26	77	8,301
2016	7,367	1,973	143.3	449.3	3.0	435.6	29	179	10,579
2017	7,414	1,985	87.2	449.3	3.0	435.6	29	179	10,582
2018	7,461	1,998	51.3	449.3	3.0	435.6	29	179	10,606
2019	7,507	2,011	26.9	449.3	3.0	435.6	29	179	10,641
2020	7,554	2,023	10.5	449.3	3.0	435.6	29	179	10,684
2021	7,601	2,036		449.3	3.0	435.6	29	179	10,733
2022	7,648	2,048		449.3	3.0	435.6	29	179	10,792
2023	7,695	2,061		337.0	3.0	435.6	29	179	10,740
2024	7,742	2,073		224.7	3.0	435.6	29	179	10,687
2025	7,789	2,086		112.3	3.0	435.6	29	179	10,634
2026	7,836	2,099			3.0	435.6	29	179	10,582
2027	7,883	2,111			3.0	435.6	29	179	10,641
2028	7,930	2,124			3.0	435.6	29	179	10,701
2029	7,977	2,136			3.0	435.6	29	179	10,760
2030	8,024	2,149			3.0	435.6	29	179	10,819
2031	8,118	2,174			3.0	435.6	29	179	10,939
2032	8,213	2,200			3.0	435.6	29	179	11,060
2033	8,308	2,225			3.0	435.6	29	179	11,180
2034	8,403	2,250			3.0	435.6	29	179	11,299
2035	8,497	2,276			3.0	435.6	29	179	11,420
2036	8,592	2,301			3.0	435.6	29	179	11,540
2037	8,687	2,326			3.0	435.6	29	179	11,659
2038	8,781	2,352			3.0	435.6	29	179	11,780
2039	8,876	2,377			3.0	435.6	29	179	11,900
2040	8,971	2,402			3.0	435.6	29	179	12,019
2041	9,066	2,428			3.0	435.6	29	179	12,140
2042	9,161	2,453			3.0	435.6	29	179	12,260
2043	9,255	2,479			3.0	435.6	29	179	12,381
2044	9,350	2,504			3.0	435.6	29	179	12,501
2045	9,445	2,530			3.0	435.6	29	179	12,622
2046	9,540	2,555			3.0	435.6	29	179	12,742
2047	9,635	2,580			3.0	435.6	29	179	12,862
2048	9,730	2,606			3.0	435.6	29	179	12,983
2049	9,825	2,631			3.0	435.6	29	179	13,102
2050	9,920	2,657			3.0	435.6	29	179	13,223
2051	9,996	2,677			3.0	435.6	29	179	13,320
2052	10,072	2,697			3.0	435.6	29	179	13,416
2053	10,148	2,718			3.0	435.6	29	179	13,513
2054	10,224	2,738			3.0	435.6	29	179	13,609
2055	10,301	2,759			3.0	435.6	29	179	13,706
2056	10,377	2,779			3.0	435.6	29	179	13,802
2057	10,453	2,799			3.0	435.6	29	179	13,899
2058	10,529	2,820			3.0	435.6	29	179	13,996
2059	10,605	2,840			3.0	435.6	29	179	14,092
2060	10,681	2,861			3.0	435.6	29	179	14,189
2061	10,719	2,871			3.0	435.6	29	179	14,236
2062	10,756	2,881			3.0	435.6	29	179	14,284
2063	10,793	2,891			3.0	435.6	29	179	14,331
2064	10,830	2,900			3.0	435.6	29	179	14,377
2065	10,867	2,910			3.0	435.6	29	179	14,424
2066	10,905	2,920			3.0	435.6	29	179	14,471
2067	10,942	2,930			3.0	435.6	29	179	14,519
2068	10,979	2,940			3.0	435.6	29	179	14,566
2069	11,016	2,950			3.0	435.6	29	179	14,613
2070	11,053	2,960			3.0	435.6	29	179	14,660

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	29.00	0
2015	1,244,270	29.00	0
2016	1,257,730	29.00	0
2017	1,270,170	29.00	0
2018	1,283,120	29.00	0
2019	1,296,070	29.00	0
2020	1,309,020	29.00	0
2021	1,321,970	29.00	0
2022	1,334,920	29.00	0
2023	1,347,870	29.00	0
2024	1,360,820	29.00	0

6 Activities with projected savings

This report contains additional tables not included in other individual reports that project DWU's conservation activities according to feedback received from utility staff. Activities itemized in this section include all active programs contained in the City of Dallas Water Utilities' Water Conservation Five-year Work Plan (2016) with projections suggested by utility staff.

In the summary of projected activity savings in Section 7, for those activities that are ongoing, past savings averages were used to make projections. For future activities, savings estimates in the plan through 2020 were used to project further into the future at the same annual rate.

6.1.1 Financial incentive, device, and fixture activities

1. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

2. **Water Rate Increases**
    b. Major rate increase from 2013 – 2016:[16]
        i. 11.125% combined base rate increase
        ii. 11.425% combined volumetric rate increase

[16] Gathered from rates listed in 2013 and in 2016 from documents collected from staff.

iii. 11.275% overall increase with 50/50 weight given to base and volumetric rate increases = 2.255% of total demand

b. Savings are cumulative and based on TWDB's Best Management Practices for Municipal Water Users Guide[17] (Texas Water Development Board, 2013), as well as Environmental Protection Agency guidelines and other sources (U.S. EPA, 1998; Whitcomb, 1999)

3. **Free Irrigation Inspections (SF/MF/C)**
   a. More than 5,700 inspections since program inception
   b. Savings estimated to be 39 MG annually in 2015 (City of Dallas Water Utilities, 2016)
   c. 20% decay rate per year attributed to customer behavior for similar programs (A&N Technical Services, 2005)
   d. Savings projected through 2050

4. **Free Water Efficiency Surveys (ICI)**
   a. More than 320 surveys conducted from 2013 – 2015 (City of Dallas Water Utilities, 2016)
   b. Estimated 107 surveys completed annually
   c. Estimated savings of 1.049 MG per year per audit
   d. Approximately 112.3 MG stand alone peak annual savings, which amounts to 337 accumulated savings across three years (2013 – 2015)
   e. Because some measures implemented during the surveys included equipment, fixtures, and other hardware, assumed a 10-year useful life for savings with no decay rate to be conservative
      i. Savings could persist longer for some hardware items, while behavioral measures could mean savings decay at a faster rate
   f. Savings projected through 2050

5. **City-owned Facilities Retrofit**
   a. From 2010 – 2015, estimated accumulated savings of 2.56 MG annually (City of Dallas Water Utilities, 2016)
   b. Estimated average savings of 426,667 gallons per year
   c. Savings assumed to be permanent as retrofitted fixtures will be replaced by equally as efficient fixtures when useful life ends
   d. Savings projected through 2050

6. **New Throne for Your Home Program (SF)**
   a. More than 91,000 toilets replaced from 2007 – 2015 (City of Dallas Water Utilities, 2016)
   b. Average of 10,111 toilets replaced each year
   c. Estimated savings of 4,307.7 gallons per year per toilet
   d. Savings assumed to be permanent because toilets will be replaced by equally as efficient toilets due to current plumbing code and efficiency standards

[17] Water Conservation Advisory Council (WCAC) estimates 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

    e. Savings projected through 2025

7. **Minor Plumbing Repair Program**
    a. 3,770 families have participated from 2007 – 2015 (City of Dallas Water Utilities, 2016)
    b. Average of 419 households per year
    c. Estimated savings of 6,894.7 gallons per year per household
    d. 2.88 MG stand alone annual savings that accumulates to 26 MG of savings across 9 years of program implementation
    e. Savings assumed to be permanent because fixtures will be replaced by equally as efficient fixtures due to current plumbing code and efficiency standards
    f. Savings projected through 2070

8. **Cost Share Program (ICI)**
    a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
    b. Savings projected through 2070
    c. No assumptions made for decay rate or useful life of savings

9. **Toilet Distribution Program (MF)**
    a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
    b. Savings projected through 2040
    c. Savings assumed to be permanent because toilets will be replaced by equally as efficient toilets due to current plumbing code and efficiency standards

10. **Free Toilet Program (ICI)**
    a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
    b. Savings projected through 2050
    c. Savings assumed to be permanent because toilets will be replaced by equally as efficient toilets due to current plumbing code and efficiency standards

11. **Academic and Non-profit Facility Incentives**
    a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
    b. Savings projected through 2040
    c. No assumptions made for decay rate or useful life of savings

12. **Irrigation System Rebate Program (SF)**
    a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
    b. Savings projected through 2050
    c. Assumed useful life of 10 years
        i. Most items available for rebate are irrigation controllers and turf replacements, which have 10-year useful life on average

13. Save Water Co. Program

a. Project initiated in Dallas's service area in 2015
b. Save Water Co. completed work on 3,720 multi-family units from 2015 – 2016.
c. Average monthly savings of 14.938 MG
d. Annualized savings of 176.26 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. In Region C, the company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.
h. Savings not projected for work that may be completed in the future

6.1.2 Ordinance, Enforcement, and Outreach Activities

14. Twice-per-week (or less) Outdoor Watering Ordinance

a. Estimated savings of 8.42% of total utility demand while ordinance in place (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

15. Enhanced Enforcement (SF)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

16. Enhanced Enforcement (MF)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

17. Enhanced Enforcement (ICI)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

18. Landscape Ordinance Amendment (SF)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

19. Landscape Ordinance Amendment (MF)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

20. Landscape Ordinance Amendment (C)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

21. Increased Outreach Efforts (MF)

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2040
c. No assumptions made for decay rate or useful life of savings

22. ICI and Large Campus Style Properties Targeted Outreach

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2040
c. No assumptions made for decay rate or useful life of savings

23. DWU Residential Rate Calculator

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2070
c. No assumptions made for decay rate or useful life of savings

24. Customer Web and Mobile Applications

a. Annual savings projections provided by DWU (City of Dallas Water Utilities, 2016)
b. Savings projected through 2050
c. No assumptions made for decay rate or useful life of savings

NOTE: Enforcement enhancement activities in Items 15 – 17 likely have a competitive effect on estimated outdoor watering ordinance savings listed in Item 14, which means that savings will be less for these activities in reality than they are when estimated alone in this report. Other outdoor water efficiency measures, such as Items 3 and 4, likely have a similar effect.

7 Summary of projected activity savings

Table 7-1. Savings from all projected activities not including water loss reduction (MG).

Year	Financial Incentive, Device + Fixture Activities	Ordinance, Enforcement + Outreach Activities	TOTAL ACTIVITY SAVINGS
2009	85	0	85
2010	160	0	160
2011	242	0	242
2012	365	7,179	7,544
2013	537	7,226	7,763
2014	679	7,273	7,952
2015	888	7,320	8,208
2016	3,119	7,395	10,515
2017	3,509	7,537	11,045
2018	3,910	7,680	11,590
2019	4,317	7,835	12,152
2020	4,722	7,995	12,717
2021	5,123	8,155	13,278
2022	5,524	8,315	13,838
2023	5,812	8,475	14,287
2024	6,100	8,635	14,735
2025	6,389	8,795	15,184
2026	6,635	8,955	15,590
2027	6,879	9,115	15,994
2028	7,125	9,275	16,400
2029	7,369	9,435	16,804
2030	7,615	9,595	17,210
2031	7,872	9,803	17,675
2032	8,130	10,011	18,141
2033	8,388	10,218	18,606
2034	8,645	10,426	19,071
2035	8,904	10,634	19,538
2036	9,161	10,842	20,003
2037	9,418	11,050	20,468
2038	9,677	11,257	20,934
2039	9,934	11,465	21,399
2040	10,192	11,673	21,865
2041	8,865	10,258	19,123
2042	9,059	10,400	19,460
2043	9,254	10,543	19,797
2044	9,448	10,686	20,134
2045	9,643	10,829	20,472
2046	9,837	10,972	20,809
2047	10,031	11,115	21,146
2048	10,226	11,258	21,484
2049	10,420	11,401	21,821
2050	10,615	11,544	22,159
2051	10,233	11,668	21,901
2052	10,255	11,792	22,047
2053	10,289	11,916	22,205
2054	10,332	12,040	22,372
2055	10,386	12,164	22,550
2056	10,450	12,289	22,739
2057	10,514	12,413	22,927
2058	10,579	12,537	23,116
2059	10,643	12,661	23,304
2060	10,708	12,785	23,493
2061	10,874	12,870	23,745
2062	11,040	12,956	23,996
2063	11,207	13,041	24,248
2064	11,372	13,126	24,498
2065	11,538	13,211	24,750
2066	11,705	13,297	25,001
2067	11,871	13,382	25,253
2068	12,037	13,467	25,504
2069	12,203	13,552	25,756
2070	12,370	13,637	26,007

Table 7-2. Savings for financial incentive, device, and fixture activities

Year	Water Rate Increases	Free Irrigation Inspections (SF/MF/C)	Free Water Efficiency Surveys (ICI)	City-owned Facilities Retrofit	New Throne for Your Home (SF)	Minor Plumbing Repair Program	Cost Share Program (ICI)	Toilet Distribution Program (MF)	Free Toilet Program (ICI)	Academic + Non-profit Facility Incentives	Irrigation System Rebate Program (SF)	Save Water Co.	TOTAL SAVINGS
2009		38.6			43.6	3							85
2010		66.5		0.4	87.1	6							160
2011		101.6		0.9	130.7	9							242
2012		177.9		1.3	174.2	12							365
2013		190.6	112	1.7	217.8	14							537
2014		173.3	225	2.1	261.3	17							679
2015		146.7	337	2.6	304.9	20						77.1	888
2016	1,973	143.3	449	3.0	348.4	23						179.3	3,119
2017	1,985	139.5	562	3.4	392.0	26	35	17.0	123	46		179.3	3,509
2018	1,998	145.4	674	3.8	435.6	29	69	34.1	246	93	3.2	179.3	3,910
2019	2,011	152.5	786	4.3	479.1	32	101	51.1	369	139	12.8	179.3	4,317
2020	2,023	156.9	899	4.7	522.7	35	131	68.1	492	185	25.1	179.3	4,722
2021	2,036	156.9	1,011	5.1	566.2	38	162	85.1	615	232	37.4	179.3	5,123
2022	2,048	156.9	1,123	5.5	609.8	40	192	102.1	738	278	49.7	179.3	5,524
2023	2,061	156.9	1,123	6.0	653.3	43	222	119.1	861	325	62.0	179.3	5,812
2024	2,073	156.9	1,123	6.4	696.9	46	253	136.1	984	371	74.3	179.3	6,100
2025	2,086	156.9	1,123	6.8	740.4	49	283	153.1	1,107	417	86.6	179.3	6,389
2026	2,099	156.9	1,123	7.3	740.4	52	314	170.1	1,230	464	98.9	179.3	6,635
2027	2,111	156.9	1,123	7.7	740.4	55	344	187.1	1,353	510	111.2	179.3	6,879
2028	2,124	156.9	1,123	8.1	740.4	58	374	204.1	1,476	557	123.5	179.3	7,125
2029	2,136	156.9	1,123	8.5	740.4	61	405	221.1	1,599	603	135.8	179.3	7,369
2030	2,149	156.9	1,123	9.0	740.4	64	435	238.1	1,722	649	148.1	179.3	7,615
2031	2,174	156.9	1,123	9.4	740.4	66	466	255.1	1,845	696	160.4	179.3	7,872
2032	2,200	156.9	1,123	9.8	740.4	69	496	272.1	1,968	742	172.7	179.3	8,130
2033	2,225	156.9	1,123	10.2	740.4	72	526	289.1	2,091	789	185.0	179.3	8,388
2034	2,250	156.9	1,123	10.7	740.4	75	557	306.1	2,214	835	197.3	179.3	8,645
2035	2,276	156.9	1,123	11.1	740.4	78	587	323.1	2,337	881	209.6	179.3	8,904
2036	2,301	156.9	1,123	11.5	740.4	81	618	340.1	2,460	928	221.9	179.3	9,161
2037	2,326	156.9	1,123	11.9	740.4	84	648	357.1	2,583	974	234.2	179.3	9,418
2038	2,352	156.9	1,123	12.4	740.4	87	678	374.1	2,706	1,021	246.5	179.3	9,677
2039	2,377	156.9	1,123	12.8	740.4	90	709	391.1	2,829	1,067	258.8	179.3	9,934
2040	2,402	156.9	1,123	13.2	740.4	92	739	408.1	2,952	1,113	271.1	179.3	10,192
2041	2,428	156.9	1,123	13.7	740.4	95	770		3,075		283.4	179.3	8,865
2042	2,453	156.9	1,123	14.1	740.4	98	800		3,198		295.7	179.3	9,059
2043	2,479	156.9	1,123	14.5	740.4	101	830		3,321		308.0	179.3	9,254
2044	2,504	156.9	1,123	14.9	740.4	104	861		3,444		320.3	179.3	9,448
2045	2,530	156.9	1,123	15.4	740.4	107	891		3,567		332.6	179.3	9,643
2046	2,555	156.9	1,123	15.8	740.4	110	922		3,690		344.9	179.3	9,837
2047	2,580	156.9	1,123	16.2	740.4	113	952		3,813		357.2	179.3	10,031
2048	2,606	156.9	1,123	16.6	740.4	116	982		3,936		369.5	179.3	10,226
2049	2,631	156.9	1,123	17.1	740.4	118	1,013		4,059		381.8	179.3	10,420
2050	2,657	156.9	1,123	17.5	740.4	121	1,043		4,182		394.1	179.3	10,615
2051	2,677	104.6	1,011	17.5	740.4	124	1,074		4,305			179.3	10,233
2052	2,697	62.8	899	17.5	740.4	127	1,104		4,428			179.3	10,255
2053	2,718	31.4	786	17.5	740.4	130	1,134		4,551			179.3	10,289
2054	2,738	10.5	674	17.5	740.4	133	1,165		4,674			179.3	10,332
2055	2,759		562	17.5	740.4	136	1,195		4,797			179.3	10,386
2056	2,779		449	17.5	740.4	139	1,226		4,920			179.3	10,450
2057	2,799		337	17.5	740.4	142	1,256		5,043			179.3	10,514
2058	2,820		225	17.5	740.4	144	1,286		5,166			179.3	10,579
2059	2,840		112	17.5	740.4	147	1,317		5,289			179.3	10,643
2060	2,861			17.5	740.4	150	1,347		5,412			179.3	10,708
2061	2,871			17.5	740.4	153	1,378		5,535			179.3	10,874
2062	2,881			17.5	740.4	156	1,408		5,658			179.3	11,040
2063	2,891			17.5	740.4	159	1,438		5,781			179.3	11,207
2064	2,900			17.5	740.4	162	1,469		5,904			179.3	11,372
2065	2,910			17.5	740.4	165	1,499		6,027			179.3	11,538
2066	2,920			17.5	740.4	168	1,530		6,150			179.3	11,705
2067	2,930			17.5	740.4	170	1,560		6,273			179.3	11,871
2068	2,940			17.5	740.4	173	1,590		6,396			179.3	12,037
2069	2,950			17.5	740.4	176	1,621		6,519			179.3	12,203
2070	2,960			17.5	740.4	179	1,651		6,642			179.3	12,370

Table 7-3. Savings for ordinance, enforcement, and outreach activities.

Year	2x Watering Ordinance	Enhanced Enforcement (SF)	Enhanced Enforcement (MF)	Enhanced Enforcement (ICI)	Landscape Ordinance Amendment (SF)	Landscape Ordinance Amendment (MF)	Landscape Ordinance Amendment (C)	Increased Outreach Efforts (MF)	ICI + Large Campus Style Properties Targeted Outreach	DWU Residential Rate Calculator	Customer Web + Mobile Applications	TOTAL SAVINGS
2009												0
2010												0
2011												0
2012	7,179											7,179
2013	7,226											7,226
2014	7,273											7,273
2015	7,320											7,320
2016	7,367	19	2	7.5								7,395
2017	7,414	39	3	15.0				22.3	5.1	3.0	35.4	7,537
2018	7,461	58	5	22.6				44.6	9.4	8.9	70.8	7,680
2019	7,507	78	7	30.1	3.4	0.6	2.6	66.9	18.2	14.8	106.2	7,835
2020	7,554	97	8	37.6	10.3	1.8	7.9	89.2	25.6	20.7	141.6	7,995
2021	7,601	117	10	45.1	17.2	3.0	13.2	111.5	33.0	26.6	177.0	8,155
2022	7,648	136	12	52.6	24.1	4.2	18.5	133.8	40.4	32.5	212.4	8,315
2023	7,695	156	13	60.1	31.0	5.4	23.8	156.1	47.8	38.4	247.8	8,475
2024	7,742	175	15	67.6	37.9	6.6	29.1	178.4	55.2	44.3	283.2	8,635
2025	7,789	195	17	75.1	44.8	7.8	34.4	200.7	62.6	50.2	318.6	8,795
2026	7,836	214	19	82.6	51.7	9.0	39.7	223.0	70.0	56.1	354.0	8,955
2027	7,883	234	20	90.1	58.6	10.2	45.0	245.3	77.4	62.0	389.4	9,115
2028	7,930	253	22	97.6	65.5	11.4	50.3	267.6	84.8	67.9	424.8	9,275
2029	7,977	273	24	105.1	72.4	12.6	55.6	289.9	92.2	73.8	460.2	9,435
2030	8,024	292	25	112.6	79.3	13.8	60.9	312.2	99.6	79.7	495.6	9,595
2031	8,118	312	27	120.1	86.2	15.0	66.2	334.5	107.0	85.6	531.0	9,803
2032	8,213	331	29	127.6	93.1	16.2	71.5	356.8	114.4	91.5	566.4	10,011
2033	8,308	351	30	135.1	100.0	17.4	76.8	379.1	121.8	97.4	601.8	10,218
2034	8,403	370	32	142.6	106.9	18.6	82.1	401.4	129.2	103.3	637.2	10,426
2035	8,497	390	34	150.1	113.8	19.8	87.4	423.7	136.6	109.2	672.6	10,634
2036	8,592	409	36	157.6	120.7	21.0	92.7	446.0	144.0	115.1	708.0	10,842
2037	8,687	429	37	165.1	127.6	22.2	98.0	468.3	151.4	121.0	743.4	11,050
2038	8,781	448	39	172.6	134.5	23.4	103.3	490.6	158.8	126.9	778.8	11,257
2039	8,876	468	41	180.1	141.4	24.6	108.6	512.9	166.2	132.8	814.2	11,465
2040	8,971	487	42	187.6	148.3	25.8	113.9	535.2	173.6	138.7	849.6	11,673
2041	9,066	507	44	195.1	155.2	27.0	119.2			144.6		10,258
2042	9,161	526	46	202.6	162.1	28.2	124.5			150.5		10,400
2043	9,255	546	47	210.1	169.0	29.4	129.8			156.4		10,543
2044	9,350	565	49	217.6	175.9	30.6	135.1			162.3		10,686
2045	9,445	585	51	225.1	182.8	31.8	140.4			168.2		10,829
2046	9,540	604	53	232.6	189.7	33.0	145.7			174.1		10,972
2047	9,635	624	54	240.1	196.6	34.2	151.0			180.0		11,115
2048	9,730	643	56	247.6	203.5	35.4	156.3			185.9		11,258
2049	9,825	663	58	255.1	210.4	36.6	161.6			191.8		11,401
2050	9,920	682	59	262.6	217.3	37.8	166.9			197.7		11,544
2051	9,996	702	61	270.1	224.2	39.0	172.2			203.6		11,668
2052	10,072	721	63	277.6	231.1	40.2	177.5			209.5		11,792
2053	10,148	741	64	285.1	238.0	41.4	182.8			215.4		11,916
2054	10,224	760	66	292.6	244.9	42.6	188.1			221.3		12,040
2055	10,301	780	68	300.1	251.8	43.8	193.4			227.2		12,164
2056	10,377	799	70	307.6	258.7	45.0	198.7			233.1		12,289
2057	10,453	819	71	315.1	265.6	46.2	204.0			239.0		12,413
2058	10,529	838	73	322.6	272.5	47.4	209.3			244.9		12,537
2059	10,605	858	75	330.1	279.4	48.6	214.6			250.8		12,661
2060	10,681	877	76	337.6	286.3	49.8	219.9			256.7		12,785
2061	10,719	897	78	345.1	293.2	51.0	225.2			262.6		12,870
2062	10,756	916	80	352.6	300.1	52.2	230.5			268.5		12,956
2063	10,793	936	81	360.1	307.0	53.4	235.8			274.4		13,041
2064	10,830	955	83	367.6	313.9	54.6	241.1			280.3		13,126
2065	10,867	975	85	375.1	320.8	55.8	246.4			286.2		13,211
2066	10,905	994	87	382.6	327.7	57.0	251.7			292.1		13,297
2067	10,942	1,014	88	390.1	334.6	58.2	257.0			298.0		13,382
2068	10,979	1,033	90	397.6	341.5	59.4	262.3			303.9		13,467
2069	11,016	1,053	92	405.1	348.4	60.6	267.6			309.8		13,552
2070	11,053	1,072	93	412.6	355.3	61.8	272.9			315.7		13,637

Table 7-4. Projected savings compared to conservation WMS supply volume (MG) in regional water plan.

Year	Total Savings from Projected Activities	Conservation WMS Volume	Over (Short)
2015	8,208	1,367	6,841
2016	10,515	1,709	8,805
2017	11,045	1,709	9,336
2018	11,590	2,051	9,539
2019	12,152	2,393	9,759
2020	12,717	3,077	9,640
2021	13,278	3,575	9,703
2022	13,838	4,073	9,766
2023	14,287	4,571	9,717
2024	14,735	5,068	9,667
2025	15,184	5,566	9,618
2026	15,590	6,064	9,525
2027	15,994	6,562	9,432
2028	16,400	7,060	9,340
2029	16,804	7,558	9,246
2030	17,210	8,056	9,154
2031	17,675	8,471	9,204
2032	18,141	8,886	9,255
2033	18,606	9,301	9,305
2034	19,071	9,716	9,355
2035	19,538	10,131	9,406
2036	20,003	10,547	9,456
2037	20,468	10,962	9,506
2038	20,934	11,377	9,558
2039	21,399	11,792	9,608
2040	21,865	12,207	9,658
2041	19,123	12,351	6,772
2042	19,460	12,495	6,965
2043	19,797	12,639	7,158
2044	20,134	12,783	7,351
2045	20,472	12,927	7,545
2046	20,809	13,071	7,738
2047	21,146	13,215	7,931
2048	21,484	13,359	8,125
2049	21,821	13,503	8,318
2050	22,159	13,647	8,511
2051	21,901	13,671	8,229
2052	22,047	13,695	8,352
2053	22,205	13,719	8,486
2054	22,372	13,743	8,629
2055	22,550	13,767	8,784
2056	22,739	13,791	8,948
2057	22,927	13,814	9,112
2058	23,116	13,838	9,278
2059	23,304	13,862	9,442
2060	23,493	13,886	9,607
2061	23,745	13,867	9,878
2062	23,996	13,848	10,148
2063	24,248	13,828	10,419
2064	24,498	13,809	10,689
2065	24,750	13,790	10,959
2066	25,001	13,771	11,230
2067	25,253	13,752	11,501
2068	25,504	13,733	11,771
2069	25,756	13,713	12,042
2070	26,007	13,694	12,313

8 Suggested activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

8.1 Suggested activities with savings estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[18]
g. See Table 8-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 8-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	10,579	0	10,579	1,172	1,709	249	1,958	9,793
2017	10,582	0	10,582	1,180	1,709	299	2,008	9,753
2018	10,606	0	10,606	1,187	2,051	349	2,400	9,393
2019	10,641	0	10,641	1,195	2,393	399	2,792	9,045
2020	10,684	0	10,684	1,202	3,077	448	3,525	8,361
2021	10,733	0	10,733	1,210	3,575	448	4,023	7,920
2022	10,792	0	10,792	1,217	4,073	448	4,521	7,488
2023	10,740	0	10,740	1,225	4,571	448	5,019	6,946
2024	10,687	0	10,687	1,232	5,068	448	5,517	6,402
2025	10,634	0	10,634	1,240	5,566	448	6,015	5,859
2026	10,582	0	10,582	1,247	6,064	448	6,513	5,316
2027	10,641	0	10,641	1,255	6,562	448	7,011	4,885
2028	10,701	0	10,701	1,262	7,060	448	7,509	4,454
2029	10,760	0	10,760	1,269	7,558	448	8,006	4,023
2030	10,819	0	10,819	1,277	8,056	448	8,504	3,592
2031	10,939	0	10,939	1,292	8,471	0	8,471	3,760
2032	11,060	0	11,060	1,307	8,886	0	8,886	3,481
2033	11,180	0	11,180	1,322	9,301	0	9,301	3,200
2034	11,299	0	11,299	1,337	9,716	0	9,716	2,920
2035	11,420	0	11,420	1,352	10,131	0	10,131	2,641
2036	11,540	0	11,540	1,367	10,547	0	10,547	2,360
2037	11,659	0	11,659	1,382	10,962	0	10,962	2,080
2038	11,780	0	11,780	1,398	11,377	0	11,377	1,801
2039	11,900	0	11,900	1,413	11,792	0	11,792	1,521
2040	12,019	0	12,019	1,428	12,207	0	12,207	1,240

Statewide Water Conservation Quantification Project
City of Denton Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Denton's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Denton's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Denton's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Denton with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	92	120	212	56	21	77	135
2016	100	125	225	70	26	96	129
2017	103	130	233	70	32	101	132
2018	106	136	241	84	37	120	121
2019	109	141	249	98	42	140	110
2020	111	146	258	125	47	173	85
2021	114	151	265	139	47	187	78
2022	117	156	272	153	47	200	72
2023	120	160	280	167	47	214	66
2024	122	165	287	181	47	228	59
2025	125	170	295	195	47	242	53
2026	128	174	302	209	47	256	46
2027	131	179	310	223	47	270	40
2028	134	184	317	237	47	284	34
2029	136	189	325	250	47	298	27
2030	139	193	332	264	47	312	21
2031	142	198	341	284	43	326	14
2032	145	204	349	303	38	341	8
2033	149	209	357	323	33	356	1
2034	152	214	366	342	28	371	(5)
2035	155	219	374	362	24	386	(12)
2036	158	224	382	381	19	400	(18)
2037	161	230	391	401	14	415	(24)
2038	164	235	399	420	9	430	(31)
2039	167	240	407	440	5	445	(37)
2040	170	245	416	460	0	460	(44)
2041	174	252	426	478	0	478	(52)
2042	178	259	437	497	0	497	(60)
2043	183	265	448	515	0	515	(68)
2044	187	272	458	534	0	534	(76)
2045	191	278	469	553	0	553	(84)
2046	195	285	480	571	0	571	(92)
2047	199	292	490	590	0	590	(100)
2048	203	298	501	609	0	609	(108)
2049	207	305	512	627	0	627	(115)
2050	211	312	522	646	0	646	(123)
2051	218	323	541	679	0	679	(137)
2052	225	335	560	711	0	711	(151)
2053	232	346	579	744	0	744	(165)
2054	239	358	597	776	0	776	(179)
2055	247	369	616	809	0	809	(193)
2056	254	381	635	842	0	842	(207)
2057	261	393	653	874	0	874	(221)
2058	268	404	672	907	0	907	(235)
2059	275	416	691	940	0	940	(249)
2060	282	427	710	972	0	972	(263)
2061	288	437	725	1,004	0	1,004	(279)
2062	294	446	740	1,036	0	1,036	(296)
2063	300	455	755	1,068	0	1,068	(313)
2064	306	465	770	1,100	0	1,100	(330)
2065	311	474	785	1,132	0	1,132	(347)
2066	317	483	800	1,164	0	1,164	(364)
2067	323	493	816	1,196	0	1,196	(381)
2068	329	502	831	1,228	0	1,228	(398)
2069	334	511	846	1,260	0	1,260	(415)
2070	340	521	861	1,293	0	1,293	(431)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Denton's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	158	0	0	0
1	2015	131,044	157	29	212	183
2	2016	136,864	157	60	225	165
3	2017	142,684	156	94	233	140
4	2018	148,505	156	130	241	111
5-year Goal	2019	154,325	155	169	249	80
6	2020	160,145	154	210	258	47
7	2021	165,308	154	253	265	12
8	2022	170,471	153	299	272	(26)
9	2023	175,633	153	346	280	(66)
10-year Goal	2024	180,796	152	396	287	(108)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Denton's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.50	0	0	0
1	2015	131,044	17.20	14	120	106
2	2016	136,864	16.90	30	125	95
3	2017	142,684	16.60	47	130	83
4	2018	148,505	16.30	65	136	71
5-year Goal	2019	154,325	16.00	84	141	57
6	2020	160,145	16.00	88	146	58
7	2021	165,308	16.00	91	151	60
8	2022	170,471	16.00	93	156	63
9	2023	175,633	16.00	96	160	64
10-year Goal	2024	180,796	16.00	99	165	66

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 120 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[17]
      i. 5.0% increase in 2015
      ii. 5.0% increase in 2016
   b. Estimated customer demand reduction of 2.0%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
   a. Project initiated in service area in 2014
   b. Save Water completed work on 608 multi-family units in 2016
   c. Average monthly savings of 1,431,279 gallons
   d. Annualized savings of 17.17 MG for the life of the retrofitted fixtures

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Save Water Co. Program	Water Rate Increases	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014	6		6
2015	12	80.3	92
2016	17	83.1	100
2017	17	85.9	103
2018	17	88.7	106
2019	17	91.4	109
2020	17	94.2	111
2021	17	97.0	114
2022	17	99.8	117
2023	17	102.5	120
2024	17	105.3	122
2025	17	108.1	125
2026	17	110.9	128
2027	17	113.7	131
2028	17	116.4	134
2029	17	119.2	136
2030	17	122.0	139
2031	17	125.1	142
2032	17	128.2	145
2033	17	131.4	149
2034	17	134.5	152
2035	17	137.6	155
2036	17	140.7	158
2037	17	143.8	161
2038	17	147.0	164
2039	17	150.1	167
2040	17	153.2	170
2041	17	157.3	174
2042	17	161.3	178
2043	17	165.4	183
2044	17	169.4	187
2045	17	173.5	191
2046	17	177.5	195
2047	17	181.6	199
2048	17	185.6	203
2049	17	189.7	207
2050	17	193.7	211
2051	17	200.9	218
2052	17	208.0	225
2053	17	215.2	232
2054	17	222.3	239
2055	17	229.5	247
2056	17	236.6	254
2057	17	243.8	261
2058	17	250.9	268
2059	17	258.1	275
2060	17	265.2	282
2061	17	271.0	288
2062	17	276.8	294
2063	17	282.6	300
2064	17	288.4	306
2065	17	294.2	311
2066	17	299.9	317
2067	17	305.7	323
2068	17	311.5	329
2069	17	317.3	334
2070	17	323.1	340

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.50	0
2015	131,044	15.00	120
2016	136,864	15.00	125
2017	142,684	15.00	130
2018	148,505	15.00	136
2019	154,325	15.00	141
2020	160,145	15.00	146
2021	165,308	15.00	151
2022	170,471	15.00	156
2023	175,633	15.00	160
2024	180,796	15.00	165

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8.42% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 700 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	100	125	225	700	70	26	96	829
2017	103	130	233	723	70	32	101	855
2018	106	136	241	746	84	37	120	867
2019	109	141	249	770	98	42	140	880
2020	111	146	258	793	125	47	173	878
2021	114	151	265	817	139	47	187	895
2022	117	156	272	840	153	47	200	912
2023	120	160	280	863	167	47	214	929
2024	122	165	287	887	181	47	228	946
2025	125	170	295	910	195	47	242	963
2026	128	174	302	934	209	47	256	980
2027	131	179	310	957	223	47	270	997
2028	134	184	317	980	237	47	284	1,014
2029	136	189	325	1004	250	47	298	1,031
2030	139	193	332	1027	264	47	312	1,048
2031	142	198	341	1053	284	43	326	1,068
2032	145	204	349	1080	303	38	341	1,088
2033	149	209	357	1106	323	33	356	1,107
2034	152	214	366	1132	342	28	371	1,127
2035	155	219	374	1159	362	24	386	1,147
2036	158	224	382	1185	381	19	400	1,167
2037	161	230	391	1211	401	14	415	1,187
2038	164	235	399	1237	420	9	430	1,207
2039	167	240	407	1264	440	5	445	1,226
2040	170	245	416	1290	460	0	460	1,246

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	100	125	225	111	70	26	96	241
2017	103	130	233	115	70	32	101	247
2018	106	136	241	119	84	37	120	240
2019	109	141	249	123	98	42	140	232
2020	111	146	258	126	125	47	173	211
2021	114	151	265	130	139	47	187	208
2022	117	156	272	134	153	47	200	206
2023	120	160	280	137	167	47	214	203
2024	122	165	287	141	181	47	228	200
2025	125	170	295	145	195	47	242	198
2026	128	174	302	149	209	47	256	195
2027	131	179	310	152	223	47	270	192
2028	134	184	317	156	237	47	284	190
2029	136	189	325	160	250	47	298	187
2030	139	193	332	163	264	47	312	184
2031	142	198	341	168	284	43	326	182
2032	145	204	349	172	303	38	341	180
2033	149	209	357	176	323	33	356	177
2034	152	214	366	180	342	28	371	175
2035	155	219	374	184	362	24	386	173
2036	158	224	382	189	381	19	400	171
2037	161	230	391	193	401	14	415	168
2038	164	235	399	197	420	9	430	166
2039	167	240	407	201	440	5	445	164
2040	170	245	416	205	460	0	460	161

3. Rain Barrels

  a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

  b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Denton County FWSD #1A Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Denton County FWSD #1A's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Denton County FWSD #1A's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Denton County FWSD #1A's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Denton County FWSD #1A with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	58	64	123	7	3	10	113
2016	66	68	134	9	3	12	121
2017	73	71	144	9	4	13	132
2018	81	75	155	11	5	15	140
2019	88	78	166	12	5	18	149
2020	95	82	177	16	6	22	155
2021	103	88	191	19	6	25	166
2022	110	95	205	22	6	28	177
2023	118	101	219	25	6	31	188
2024	125	108	232	28	6	34	199
2025	132	114	246	31	6	37	210
2026	140	120	260	34	6	40	220
2027	147	127	274	37	6	43	231
2028	155	133	288	40	6	46	242
2029	162	140	302	43	6	49	253
2030	169	146	315	46	6	51	264
2031	173	149	322	49	5	54	268
2032	176	152	328	52	5	56	271
2033	179	155	334	55	4	59	275
2034	183	158	340	58	4	61	279
2035	186	161	347	61	3	64	283
2036	189	164	353	64	2	66	287
2037	193	166	359	67	2	69	290
2038	196	169	365	70	1	71	294
2039	199	172	372	73	1	74	298
2040	203	175	378	76	0	76	302
2041	203	175	378	77	0	77	301
2042	203	175	378	78	0	78	300
2043	203	175	378	79	0	79	299
2044	203	175	378	80	0	80	298
2045	203	175	378	80	0	80	298
2046	203	175	378	81	0	81	297
2047	203	175	378	82	0	82	296
2048	203	175	378	83	0	83	295
2049	203	175	378	84	0	84	294
2050	203	175	378	84	0	84	293
2051	203	175	378	85	0	85	293
2052	203	175	378	86	0	86	292
2053	203	175	378	87	0	87	291
2054	203	175	378	88	0	88	290
2055	203	175	378	89	0	89	289
2056	203	175	378	89	0	89	288
2057	203	175	378	90	0	90	287
2058	203	175	378	91	0	91	287
2059	203	175	378	92	0	92	286
2060	203	175	378	93	0	93	285
2061	203	175	378	94	0	94	284
2062	203	175	378	95	0	95	283
2063	203	175	378	95	0	95	282
2064	203	175	378	96	0	96	282
2065	203	175	378	97	0	97	281
2066	203	175	378	98	0	98	280
2067	203	175	378	99	0	99	279
2068	203	175	378	99	0	99	278
2069	203	175	378	100	0	100	278
2070	203	175	378	101	0	101	277

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Denton County FWSD #1A's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	230	0	0	0
1	2010	7,371	228	6	-	-
2	2011	8,097	225	14	-	-
3	2012	8,823	223	23	36	13
4	2013	9,548	220	33	44	10
5-year Goal	2014	10,274	218	45	51	6
6	2015	11,000	216	57	123	66
7	2016	11,600	214	69	134	64
8	2017	12,200	211	83	144	62
9	2018	12,800	209	97	155	58
10-year Goal	2019	13,400	207	112	166	54

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Denton County FWSD #1A's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	38.00	0	0	0
1	2010	7,371	35.40	7	-	-
2	2011	8,097	32.80	15	-	-
3	2012	8,823	30.20	25	-	-
4	2013	9,548	27.60	36	-	-
5-year Goal	2014	10,274	25.00	49	-	-
6	2015	11,000	25.00	52	64	12
7	2016	11,600	25.00	55	68	13
8	2017	12,200	25.00	58	71	13
9	2018	12,800	25.00	61	75	14
10-year Goal	2019	13,400	25.00	64	78	15

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 64 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	TOTAL SAVINGS
2012	36	36
2013	44	44
2014	51	51
2015	58	58
2016	66	66
2017	73	73
2018	81	81
2019	88	88
2020	95	95
2021	103	103
2022	110	110
2023	118	118
2024	125	125
2025	132	132
2026	140	140
2027	147	147
2028	155	155
2029	162	162
2030	169	169
2031	173	173
2032	176	176
2033	179	179
2034	183	183
2035	186	186
2036	189	189
2037	193	193
2038	196	196
2039	199	199
2040	203	203
2041	203	203
2042	203	203
2043	203	203
2044	203	203
2045	203	203
2046	203	203
2047	203	203
2048	203	203
2049	203	203
2050	203	203
2051	203	203
2052	203	203
2053	203	203
2054	203	203
2055	203	203
2056	203	203
2057	203	203
2058	203	203
2059	203	203
2060	203	203
2061	203	203
2062	203	203
2063	203	203
2064	203	203
2065	203	203
2066	203	203
2067	203	203
2068	203	203
2069	203	203
2070	203	203

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	38.00	0
2015	11,000	22.00	64
2016	11,600	22.00	68
2017	12,200	22.00	71
2018	12,800	22.00	75
2019	13,400	22.00	78
2020	14,000	22.00	82
2021	15,102	22.00	88
2022	16,204	22.00	95
2023	17,306	22.00	101
2024	18,408	22.00	108

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	66	68	134	11	9	3	12	132
2017	73	71	144	12	9	4	13	144
2018	81	75	155	14	11	5	15	154
2019	88	78	166	15	12	5	18	163
2020	95	82	177	16	16	6	22	171
2021	103	88	191	17	19	6	25	183
2022	110	95	205	18	22	6	28	196
2023	118	101	219	20	25	6	31	208
2024	125	108	232	21	28	6	34	220
2025	132	114	246	22	31	6	37	232
2026	140	120	260	23	34	6	40	244
2027	147	127	274	25	37	6	43	256
2028	155	133	288	26	40	6	46	268
2029	162	140	302	27	43	6	49	280
2030	169	146	315	28	46	6	51	292
2031	173	149	322	29	49	5	54	297
2032	176	152	328	29	52	5	56	301
2033	179	155	334	30	55	4	59	305
2034	183	158	340	31	58	4	61	310
2035	186	161	347	31	61	3	64	314
2036	189	164	353	32	64	2	66	318
2037	193	166	359	32	67	2	69	323
2038	196	169	365	33	70	1	71	327
2039	199	172	372	33	73	1	74	331
2040	203	175	378	34	76	0	76	336

2. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 16 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	66	68	134	16	9	3	12	138
2017	73	71	144	18	9	4	13	150
2018	81	75	155	20	11	5	15	160
2019	88	78	166	22	12	5	18	171
2020	95	82	177	24	16	6	22	179
2021	103	88	191	26	19	6	25	192
2022	110	95	205	28	22	6	28	205
2023	118	101	219	29	25	6	31	217
2024	125	108	232	31	28	6	34	230
2025	132	114	246	33	31	6	37	243
2026	140	120	260	35	34	6	40	255
2027	147	127	274	37	37	6	43	268
2028	155	133	288	39	40	6	46	281
2029	162	140	302	40	43	6	49	294
2030	169	146	315	42	46	6	51	306
2031	173	149	322	43	49	5	54	311
2032	176	152	328	44	52	5	56	315
2033	179	155	334	45	55	4	59	320
2034	183	158	340	46	58	4	61	325
2035	186	161	347	47	61	3	64	329
2036	189	164	353	47	64	2	66	334
2037	193	166	359	48	67	2	69	339
2038	196	169	365	49	70	1	71	343
2039	199	172	372	50	73	1	74	348
2040	203	175	378	51	76	0	76	352

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of DeSoto Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares DeSoto's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) DeSoto's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in DeSoto's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

---

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for DeSoto with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	42	(19)	22	18	14	32	(10)
2016	42	(19)	23	23	17	40	(17)
2017	42	(19)	23	23	20	43	(21)
2018	42	(20)	23	27	24	51	(28)
2019	43	(20)	23	32	27	59	(36)
2020	43	(20)	23	41	31	72	(49)
2021	43	(20)	23	44	34	78	(55)
2022	44	(20)	23	47	37	85	(61)
2023	44	(21)	24	50	41	91	(68)
2024	44	(21)	24	53	44	98	(74)
2025	45	(21)	24	56	48	104	(80)
2026	45	(21)	24	59	51	110	(87)
2027	45	(21)	24	62	55	117	(93)
2028	46	(21)	24	65	58	123	(99)
2029	46	(22)	24	68	61	130	(106)
2030	46	(22)	24	71	65	136	(112)
2031	47	(22)	24	75	64	139	(114)
2032	47	(22)	25	78	63	141	(116)
2033	47	(22)	25	82	61	143	(118)
2034	48	(23)	25	85	60	145	(121)
2035	48	(23)	25	89	59	148	(123)
2036	48	(23)	25	92	58	150	(125)
2037	49	(23)	25	96	57	152	(127)
2038	49	(23)	25	99	55	155	(129)
2039	49	(24)	26	103	54	157	(131)
2040	50	(24)	26	106	53	159	(134)
2041	50	(24)	26	108	54	162	(136)
2042	50	(24)	26	111	54	165	(138)
2043	51	(24)	26	113	54	167	(141)
2044	51	(25)	27	115	55	170	(143)
2045	52	(25)	27	117	55	172	(146)
2046	52	(25)	27	119	56	175	(148)
2047	52	(25)	27	121	56	177	(150)
2048	53	(26)	27	123	57	180	(153)
2049	53	(26)	27	126	57	183	(155)
2050	54	(26)	28	128	57	185	(157)
2051	54	(26)	28	130	58	188	(160)
2052	55	(26)	28	133	58	191	(163)
2053	55	(27)	28	135	59	194	(165)
2054	55	(27)	29	137	59	196	(168)
2055	56	(27)	29	140	60	199	(171)
2056	56	(27)	29	142	60	202	(173)
2057	57	(27)	29	144	61	205	(176)
2058	57	(28)	29	147	61	208	(178)
2059	57	(28)	30	149	61	211	(181)
2060	58	(28)	30	152	62	213	(184)
2061	58	(28)	30	154	62	217	(187)
2062	59	(29)	30	157	63	220	(189)
2063	59	(29)	30	159	63	223	(192)
2064	60	(29)	31	162	64	226	(195)
2065	60	(29)	31	165	64	229	(198)
2066	60	(29)	31	167	65	232	(201)
2067	61	(30)	31	170	65	235	(204)
2068	61	(30)	32	172	66	238	(206)
2069	62	(30)	32	175	66	241	(209)
2070	62	(30)	32	178	66	244	(212)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how DeSoto's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	152	0	0	0
1	2015	52,486	151	15	22	7
2	2016	52,912	150	31	23	(8)
3	2017	53,338	150	47	23	(24)
4	2018	53,765	149	63	23	(40)
5-year Goal	2019	54,191	148	79	23	(56)
6	2020	54,617	147	92	23	(69)
7	2021	55,146	147	105	23	(81)
8	2022	55,674	146	118	23	(94)
9	2023	56,203	146	131	24	(108)
10-year Goal	2024	56,731	145	145	24	(121)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how DeSoto's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	21.00	0	0	0
1	2015	52,486	20.80	4	(19)	(23)
2	2016	52,912	20.60	8	(19)	(27)
3	2017	53,338	20.40	12	(19)	(31)
4	2018	53,765	20.20	16	(20)	(35)
5-year Goal	2019	54,191	20.00	20	(20)	(40)
6	2020	54,617	19.80	24	(20)	(44)
7	2021	55,146	19.60	28	(20)	(48)
8	2022	55,674	19.40	33	(20)	(53)
9	2023	56,203	19.20	37	(21)	(57)
10-year Goal	2024	56,731	19.00	41	(21)	(62)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits
        ii. Water University classes with Texas A&M AgriLife

3. **Water Loss Reduction Savings**[14]
    a. Loss of 19 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[16]
        i. 1.52% increase in 2014
        ii. 5.6% increase in 2015
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	8.8	9
2015	41.5	42
2016	41.8	42
2017	42.1	42
2018	42.5	42
2019	42.8	43
2020	43.1	43
2021	43.4	43
2022	43.7	44
2023	44.0	44
2024	44.3	44
2025	44.6	45
2026	45.0	45
2027	45.3	45
2028	45.6	46
2029	45.9	46
2030	46.2	46
2031	46.6	47
2032	46.9	47
2033	47.2	47
2034	47.6	48
2035	47.9	48
2036	48.3	48
2037	48.6	49
2038	48.9	49
2039	49.3	49
2040	49.6	50
2041	50.0	50
2042	50.4	50
2043	50.8	51
2044	51.3	51
2045	51.7	52
2046	52.1	52
2047	52.5	52
2048	52.9	53
2049	53.3	53
2050	53.7	54
2051	54.1	54
2052	54.5	55
2053	54.9	55
2054	55.4	55
2055	55.8	56
2056	56.2	56
2057	56.6	57
2058	57.0	57
2059	57.5	57
2060	57.9	58
2061	58.3	58
2062	58.7	59
2063	59.2	59
2064	59.6	60
2065	60.0	60
2066	60.5	60
2067	60.9	61
2068	61.3	61
2069	61.7	62
2070	62.2	62

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	21.00	0
2015	52,486	22.00	(19)
2016	52,912	22.00	(19)
2017	53,338	22.00	(19)
2018	53,765	22.00	(20)
2019	54,191	22.00	(20)
2020	54,617	22.00	(20)
2021	55,146	22.00	(20)
2022	55,674	22.00	(20)
2023	56,203	22.00	(21)
2024	56,731	22.00	(21)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   - **a.** Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
     - i. Average Region C savings
     - ii. Specific percentage of outdoor usage unknown for your utility at this time
   - **b.** Savings could be 239 MG per year with current demand.
   - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	42	(19)	23	239	23	17	40	222
2017	42	(19)	23	241	23	20	43	220
2018	42	(20)	23	243	27	24	51	214
2019	43	(20)	23	244	32	27	59	208
2020	43	(20)	23	246	41	31	72	198
2021	43	(20)	23	248	44	34	78	193
2022	44	(20)	23	250	47	37	85	189
2023	44	(21)	24	252	50	41	91	184
2024	44	(21)	24	253	53	44	98	179
2025	45	(21)	24	255	56	48	104	175
2026	45	(21)	24	257	59	51	110	170
2027	45	(21)	24	259	62	55	117	166
2028	46	(21)	24	260	65	58	123	161
2029	46	(22)	24	262	68	61	130	157
2030	46	(22)	24	264	71	65	136	152
2031	47	(22)	24	266	75	64	139	152
2032	47	(22)	25	268	78	63	141	152
2033	47	(22)	25	270	82	61	143	152
2034	48	(23)	25	272	85	60	145	151
2035	48	(23)	25	274	89	59	148	151
2036	48	(23)	25	276	92	58	150	151
2037	49	(23)	25	278	96	57	152	151
2038	49	(23)	25	280	99	55	155	150
2039	49	(24)	26	282	103	54	157	150
2040	50	(24)	26	284	106	53	159	150

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	42	(19)	23	40	23	17	40	23
2017	42	(19)	23	40	23	20	43	20
2018	42	(20)	23	41	27	24	51	12
2019	43	(20)	23	41	32	27	59	5
2020	43	(20)	23	41	41	31	72	(7)
2021	43	(20)	23	42	44	34	78	(13)
2022	44	(20)	23	42	47	37	85	(19)
2023	44	(21)	24	42	50	41	91	(25)
2024	44	(21)	24	42	53	44	98	(31)
2025	45	(21)	24	43	56	48	104	(37)
2026	45	(21)	24	43	59	51	110	(44)
2027	45	(21)	24	43	62	55	117	(50)
2028	46	(21)	24	44	65	58	123	(56)
2029	46	(22)	24	44	68	61	130	(62)
2030	46	(22)	24	44	71	65	136	(68)
2031	47	(22)	24	45	75	64	139	(69)
2032	47	(22)	25	45	78	63	141	(71)
2033	47	(22)	25	45	82	61	143	(73)
2034	48	(23)	25	46	85	60	145	(75)
2035	48	(23)	25	46	89	59	148	(77)
2036	48	(23)	25	46	92	58	150	(79)
2037	49	(23)	25	47	96	57	152	(81)
2038	49	(23)	25	47	99	55	155	(82)
2039	49	(24)	26	47	103	54	157	(84)
2040	50	(24)	26	48	106	53	159	(86)

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Duncanville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Duncanville's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Duncanville's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Duncanville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMG Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Duncanville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	57.5	(363)	(306)	3	4	7	(313)
2016	96.6	(369)	(272)	4	5	9	(282)
2017	97.1	(375)	(278)	4	7	10	(288)
2018	97.5	(380)	(283)	4	8	12	(295)
2019	98.0	(386)	(288)	5	9	14	(302)
2020	98.5	(392)	(293)	7	10	16	(309)
2021	99.0	(396)	(297)	7	10	17	(314)
2022	99.5	(399)	(300)	8	10	18	(318)
2023	100.0	(403)	(303)	9	10	19	(322)
2024	100.5	(407)	(307)	10	10	19	(326)
2025	100.9	(411)	(310)	10	10	20	(330)
2026	101.4	(415)	(313)	11	10	21	(334)
2027	101.9	(418)	(316)	12	10	22	(338)
2028	102.4	(422)	(320)	13	10	22	(342)
2029	102.9	(426)	(323)	13	10	23	(346)
2030	103.4	(430)	(326)	14	10	24	(350)
2031	103.2	(430)	(327)	15	9	23	(350)
2032	103.0	(430)	(327)	15	8	23	(350)
2033	102.8	(430)	(327)	16	7	23	(350)
2034	102.6	(430)	(327)	17	6	22	(350)
2035	102.4	(430)	(327)	17	5	22	(350)
2036	102.3	(430)	(328)	18	4	22	(349)
2037	102.1	(430)	(328)	19	3	22	(349)
2038	101.9	(430)	(328)	19	2	21	(349)
2039	101.7	(430)	(328)	20	1	21	(349)
2040	101.5	(430)	(328)	21	0	21	(349)
2041	101.4	(430)	(328)	21	0	21	(350)
2042	101.3	(430)	(329)	22	0	22	(350)
2043	101.2	(430)	(329)	22	0	22	(351)
2044	101.1	(430)	(329)	23	0	23	(352)
2045	101.0	(430)	(329)	24	0	24	(353)
2046	100.9	(430)	(329)	24	0	24	(353)
2047	100.8	(430)	(329)	25	0	25	(354)
2048	100.7	(430)	(329)	26	0	26	(355)
2049	100.6	(430)	(329)	26	0	26	(356)
2050	100.5	(430)	(329)	27	0	27	(356)
2051	100.5	(430)	(329)	28	0	28	(357)
2052	100.5	(430)	(329)	28	0	28	(358)
2053	100.5	(430)	(329)	29	0	29	(358)
2054	100.4	(430)	(329)	30	0	30	(359)
2055	100.4	(430)	(329)	30	0	30	(360)
2056	100.4	(430)	(329)	31	0	31	(360)
2057	100.4	(430)	(329)	32	0	32	(361)
2058	100.4	(430)	(329)	32	0	32	(362)
2059	100.3	(430)	(329)	33	0	33	(362)
2060	100.3	(430)	(330)	34	0	34	(363)
2061	100.3	(430)	(330)	34	0	34	(364)
2062	100.3	(430)	(330)	35	0	35	(364)
2063	100.3	(430)	(330)	36	0	36	(365)
2064	100.3	(430)	(330)	36	0	36	(366)
2065	100.3	(430)	(330)	37	0	37	(367)
2066	100.3	(430)	(330)	38	0	38	(367)
2067	100.3	(430)	(330)	38	0	38	(368)
2068	100.3	(430)	(330)	39	0	39	(369)
2069	100.3	(430)	(330)	40	0	40	(369)
2070	100.3	(430)	(330)	40	0	40	(370)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Duncanville's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	127	0	0	0
1	2015	39,826	127	6	(306)	(312)
2	2016	40,446	126	12	(272)	(284)
3	2017	41,066	126	18	(278)	(296)
4	2018	41,687	125	24	(283)	(307)
5-year Goal	2019	42,307	125	31	(288)	(319)
6	2020	42,927	124	41	(293)	(334)
7	2021	43,345	124	51	(297)	(347)
8	2022	43,763	123	61	(300)	(361)
9	2023	44,181	123	71	(303)	(374)
10-year Goal	2024	44,599	122	81	(307)	(388)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Duncanville's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	11.00	0	0	0
1	2015	39,826	10.40	9	(363)	(372)
2	2016	40,446	9.80	18	(369)	(387)
3	2017	41,066	9.20	27	(375)	(402)
4	2018	41,687	8.60	37	(380)	(417)
5-year Goal	2019	42,307	8.00	46	(386)	(432)
6	2020	42,927	7.60	53	(392)	(445)
7	2021	43,345	7.20	60	(396)	(456)
8	2022	43,763	6.80	67	(399)	(466)
9	2023	44,181	6.40	74	(403)	(477)
10-year Goal	2024	44,599	6.00	81	(407)	(488)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Loss of 363 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[16]
        i. 10% increase in 2015
        ii. 10% increase in 2016
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Save Water Co. Commercial, Multi-family and Hotel Programs**[18]
    a. Project initiated in service area in 2015
    b. Save Water completed work on 440 multi-family units in 2015
    c. Average monthly savings of 1,620,772 gallons
    d. Annualized savings of 19.45 MG for the life of the retrofitted fixtures

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[18] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Save Water Co. Program	Water Rate Increases	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014			0
2015	19.45	38	57.5
2016	19.45	77	96.6
2017	19.45	78	97.1
2018	19.45	78	97.5
2019	19.45	79	98.0
2020	19.45	79	98.5
2021	19.45	80	99.0
2022	19.45	80	99.5
2023	19.45	81	100.0
2024	19.45	81	100.5
2025	19.45	81	100.9
2026	19.45	82	101.4
2027	19.45	82	101.9
2028	19.45	83	102.4
2029	19.45	83	102.9
2030	19.45	84	103.4
2031	19.45	84	103.2
2032	19.45	84	103.0
2033	19.45	83	102.8
2034	19.45	83	102.6
2035	19.45	83	102.4
2036	19.45	83	102.3
2037	19.45	83	102.1
2038	19.45	82	101.9
2039	19.45	82	101.7
2040	19.45	82	101.5
2041	19.45	82	101.4
2042	19.45	82	101.3
2043	19.45	82	101.2
2044	19.45	82	101.1
2045	19.45	82	101.0
2046	19.45	81	100.9
2047	19.45	81	100.8
2048	19.45	81	100.7
2049	19.45	81	100.6
2050	19.45	81	100.5
2051	19.45	81	100.5
2052	19.45	81	100.5
2053	19.45	81	100.5
2054	19.45	81	100.4
2055	19.45	81	100.4
2056	19.45	81	100.4
2057	19.45	81	100.4
2058	19.45	81	100.4
2059	19.45	81	100.3
2060	19.45	81	100.3
2061	19.45	81	100.3
2062	19.45	81	100.3
2063	19.45	81	100.3
2064	19.45	81	100.3
2065	19.45	81	100.3
2066	19.45	81	100.3
2067	19.45	81	100.3
2068	19.45	81	100.3
2069	19.45	81	100.3
2070	19.45	81	100.3

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	11.00	0
2015	39,826	36.00	(363)
2016	40,446	36.00	(369)
2017	41,066	36.00	(375)
2018	41,687	36.00	(380)
2019	42,307	36.00	(386)
2020	42,927	36.00	(392)
2021	43,345	36.00	(396)
2022	43,763	36.00	(399)
2023	44,181	36.00	(403)
2024	44,599	36.00	(407)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 6.95% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 134 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	97	(369)	(272)	134	4	5	9	(148)
2017	97	(375)	(278)	135	4	7	10	(153)
2018	98	(380)	(283)	136	4	8	12	(159)
2019	98	(386)	(288)	137	5	9	14	(165)
2020	99	(392)	(293)	137	7	10	16	(172)
2021	99	(396)	(297)	138	7	10	17	(175)
2022	99	(399)	(300)	139	8	10	18	(179)
2023	100	(403)	(303)	140	9	10	19	(182)
2024	100	(407)	(307)	141	10	10	19	(185)
2025	101	(411)	(310)	142	10	10	20	(188)
2026	101	(415)	(313)	142	11	10	21	(192)
2027	102	(418)	(316)	143	12	10	22	(195)
2028	102	(422)	(320)	144	13	10	22	(198)
2029	103	(426)	(323)	145	13	10	23	(201)
2030	103	(430)	(326)	146	14	10	24	(204)
2031	103	(430)	(327)	145	15	9	23	(205)
2032	103	(430)	(327)	145	15	8	23	(205)
2033	103	(430)	(327)	145	16	7	23	(205)
2034	103	(430)	(327)	145	17	6	22	(205)
2035	102	(430)	(327)	144	17	5	22	(205)
2036	102	(430)	(328)	144	18	4	22	(206)
2037	102	(430)	(328)	144	19	3	22	(206)
2038	102	(430)	(328)	143	19	2	21	(206)
2039	102	(430)	(328)	143	20	1	21	(206)
2040	102	(430)	(328)	143	21	0	21	(206)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	97	(369)	(272)	26	4	5	9	(256)
2017	97	(375)	(278)	26	4	7	10	(262)
2018	98	(380)	(283)	26	4	8	12	(269)
2019	98	(386)	(288)	26	5	9	14	(275)
2020	99	(392)	(293)	26	7	10	16	(283)
2021	99	(396)	(297)	27	7	10	17	(287)
2022	99	(399)	(300)	27	8	10	18	(291)
2023	100	(403)	(303)	27	9	10	19	(295)
2024	100	(407)	(307)	27	10	10	19	(299)
2025	101	(411)	(310)	27	10	10	20	(303)
2026	101	(415)	(313)	27	11	10	21	(306)
2027	102	(418)	(316)	28	12	10	22	(310)
2028	102	(422)	(320)	28	13	10	22	(314)
2029	103	(426)	(323)	28	13	10	23	(318)
2030	103	(430)	(326)	28	14	10	24	(322)
2031	103	(430)	(327)	28	15	9	23	(322)
2032	103	(430)	(327)	28	15	8	23	(322)
2033	103	(430)	(327)	28	16	7	23	(322)
2034	103	(430)	(327)	28	17	6	22	(322)
2035	102	(430)	(327)	28	17	5	22	(322)
2036	102	(430)	(328)	28	18	4	22	(322)
2037	102	(430)	(328)	28	19	3	22	(322)
2038	102	(430)	(328)	28	19	2	21	(322)
2039	102	(430)	(328)	28	20	1	21	(321)
2040	102	(430)	(328)	27	21	0	21	(321)

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
East Fork SUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares East Fork SUD's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) East Fork SUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in East Fork SUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for East Fork SUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	13	52	65	0	0	1	65
2016	13	50	63	0	1	1	62
2017	21	52	73	0	1	1	72
2018	21	55	76	0	1	1	75
2019	22	58	80	1	1	1	78
2020	23	60	83	1	1	2	81
2021	23	63	86	1	1	2	85
2022	24	66	90	1	1	2	88
2023	24	69	93	1	1	2	91
2024	25	69	94	1	1	2	92
2025	26	70	96	1	1	2	94
2026	26	71	97	1	1	2	95
2027	27	72	98	1	1	2	96
2028	27	73	100	1	1	2	97
2029	28	73	101	2	1	3	99
2030	29	74	103	2	1	3	100
2031	29	75	104	2	1	3	102
2032	30	76	106	2	1	3	103
2033	31	77	107	2	1	3	104
2034	31	78	110	2	1	3	107
2035	32	80	112	2	0	3	109
2036	33	82	114	2	0	3	112
2037	33	84	117	3	0	3	114
2038	34	85	119	3	0	3	116
2039	35	87	122	3	0	3	119
2040	35	89	124	3	0	3	121
2041	36	91	127	3	0	3	124
2042	37	93	129	3	0	3	126
2043	38	94	132	3	0	3	128
2044	38	98	136	4	0	4	133
2045	39	102	141	4	0	4	137
2046	40	105	145	4	0	4	141
2047	41	109	149	4	0	4	145
2048	41	113	154	4	0	4	150
2049	42	116	158	4	0	4	154
2050	43	120	163	5	0	5	158
2051	44	124	167	5	0	5	162
2052	44	127	172	5	0	5	167
2053	45	131	176	5	0	5	171
2054	46	135	181	6	0	6	175
2055	47	139	186	6	0	6	180
2056	48	143	191	6	0	6	185
2057	49	147	196	6	0	6	189
2058	49	151	200	7	0	7	194
2059	50	155	205	7	0	7	198
2060	51	159	210	7	0	7	203
2061	52	163	215	7	0	7	208
2062	53	167	220	8	0	8	212
2063	54	171	225	8	0	8	217
2064	55	176	231	8	0	8	223
2065	56	181	237	8	0	8	229
2066	57	187	243	9	0	9	235
2067	57	192	249	9	0	9	240
2068	58	197	256	9	0	9	246
2069	59	202	262	10	0	10	252
2070	60	208	268	10	0	10	258

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how East Fork SUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	145	0	0	0
1	2015	11,058	145	0	65	65
2	2016	11,607	145	0	63	63
3	2017	12,156	145	0	73	73
4	2018	12,704	145	0	76	76
5-year Goal	2019	13,253	145	0	80	80
6	2020	13,802	145	0	83	83
7	2021	13,964	145	0	86	86
8	2022	14,127	145	0	90	90
9	2023	14,289	145	0	93	93
10-year Goal	2024	14,452	145	0	94	94

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how East Fork SUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	11,058	17.00	0	52	52
2	2016	11,607	17.00	0	50	50
3	2017	12,156	17.00	0	52	52
4	2018	12,704	17.00	0	55	55
5-year Goal	2019	13,253	17.00	0	58	58
6	2020	13,802	17.00	0	60	60
7	2021	13,964	17.00	0	63	63
8	2022	14,127	17.00	0	66	66
9	2023	14,289	17.00	0	69	69
10-year Goal	2024	14,452	17.00	0	69	69

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 52 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 20.7% increase in 2017
    b. Estimated customer demand reduction of 4.14%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)

b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2012			0
2013			0
2014			0
2015	13		13
2016	13		13
2017	14	7	21
2018	14	7	21
2019	15	8	22
2020	15	8	23
2021	15	8	23
2022	16	8	24
2023	16	8	24
2024	16	9	25
2025	17	9	26
2026	17	9	26
2027	18	9	27
2028	18	9	27
2029	18	10	28
2030	19	10	29
2031	19	10	29
2032	20	10	30
2033	20	10	31
2034	21	11	31
2035	21	11	32
2036	21	11	33
2037	22	11	33
2038	22	12	34
2039	23	12	35
2040	23	12	35
2041	24	12	36
2042	24	13	37
2043	25	13	38
2044	25	13	38
2045	26	13	39
2046	26	14	40
2047	27	14	41
2048	27	14	41
2049	28	14	42
2050	28	15	43
2051	29	15	44
2052	29	15	44
2053	30	15	45
2054	30	16	46
2055	31	16	47
2056	32	16	48
2057	32	17	49
2058	33	17	49
2059	33	17	50
2060	34	17	51
2061	34	18	52
2062	35	18	53
2063	35	18	54
2064	36	19	55
2065	37	19	56
2066	37	19	57
2067	38	20	57
2068	38	20	58
2069	39	20	59
2070	40	21	60

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	9,547	2.00	52
2016	10,051	3.38	50
2017	10,554	3.38	52
2018	11,058	3.38	55
2019	11,607	3.38	58
2020	12,156	3.38	60
2021	12,704	3.38	63
2022	13,253	3.38	66
2023	13,802	3.38	69
2024	13,964	3.38	69

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	13	50	63	2	0	1	1	65
2017	21	52	73	2	0	1	1	75
2018	21	55	76	2	0	1	1	78
2019	22	58	80	2	1	1	1	81
2020	23	60	83	2	1	1	2	84
2021	23	63	86	3	1	1	2	87
2022	24	66	90	3	1	1	2	90
2023	24	69	93	3	1	1	2	94
2024	25	69	94	3	1	1	2	95
2025	26	70	96	3	1	1	2	96
2026	26	71	97	3	1	1	2	98
2027	27	72	98	3	1	1	2	99
2028	27	73	100	3	1	1	2	100
2029	28	73	101	3	2	1	3	102
2030	29	74	103	3	2	1	3	103
2031	29	75	104	3	2	1	3	105
2032	30	76	106	3	2	1	3	106
2033	31	77	107	3	2	1	3	108
2034	31	78	110	3	2	1	3	110
2035	32	80	112	4	2	0	3	113
2036	33	82	114	4	2	0	3	115
2037	33	84	117	4	3	0	3	118
2038	34	85	119	4	3	0	3	120
2039	35	87	122	4	3	0	3	123
2040	35	89	124	4	3	0	3	125

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Euless Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, we first engaged with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

We then quantified each utility's conservation activities through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Euless's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Euless's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Euless's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. We are not aware of all activities that are ongoing. Some activities within a utility's service area are implemented on a micro-scale that we cannot yet quantify. Individual households and businesses may be implementing conservation measures that we do not know about and therefore cannot include in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures we have carried forward in our model because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. Our approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Euless with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. Because the regional

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, we have quantified utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	97	257	354	28	6	34	320
2016	155	257	412	34	8	43	370
2017	156	257	413	34	10	44	369
2018	156	257	413	41	11	53	360
2019	156	257	414	48	13	61	352
2020	157	257	414	62	15	77	337
2021	157	259	416	66	15	80	335
2022	158	260	418	69	15	84	334
2023	158	261	419	73	15	88	332
2024	158	263	421	77	15	91	330
2025	159	264	423	81	15	95	328
2026	159	266	425	84	15	99	326
2027	160	267	427	88	15	103	324
2028	160	268	428	92	15	106	322
2029	160	270	430	95	15	110	320
2030	161	271	432	99	15	114	318
2031	160	271	432	100	13	113	319
2032	160	271	431	101	12	112	319
2033	160	271	431	101	10	112	319
2034	160	271	431	102	9	111	320
2035	159	271	430	103	7	110	320
2036	159	271	430	104	6	110	320
2037	159	271	430	105	4	109	321
2038	158	271	429	106	3	108	321
2039	158	271	429	106	1	108	321
2040	158	271	429	107	0	107	322
2041	157	271	429	100	0	100	328
2042	157	271	428	93	0	93	335
2043	157	271	428	86	0	86	342
2044	157	271	428	80	0	80	349
2045	157	271	428	73	0	73	355
2046	157	271	428	66	0	66	362
2047	156	271	428	59	0	59	369
2048	156	271	427	52	0	52	376
2049	156	271	427	45	0	45	382
2050	156	271	427	38	0	38	389
2051	156	271	427	39	0	39	388
2052	156	271	427	40	0	40	387
2053	156	271	427	41	0	41	386
2054	156	271	427	42	0	42	385
2055	156	271	427	43	0	43	384
2056	156	271	427	44	0	44	383
2057	156	271	427	45	0	45	382
2058	156	271	427	46	0	46	381
2059	156	271	427	47	0	47	380
2060	156	271	427	48	0	48	379
2061	156	271	427	49	0	49	378
2062	156	271	427	50	0	50	377
2063	156	271	427	51	0	51	375
2064	156	271	427	52	0	52	374
2065	156	271	427	54	0	54	373
2066	156	271	427	55	0	55	372
2067	156	271	427	56	0	56	371
2068	156	271	427	57	0	57	370
2069	156	271	427	58	0	58	369
2070	156	271	427	59	0	59	368

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Euless's quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	141	0	0	0
1	2015	54,219	141	0	354	354
2	2016	54,218	141	0	412	412
3	2017	54,217	141	0	413	413
4	2018	54,216	141	0	413	413
5-year Goal	2019	54,215	141	0	414	414
6	2020	54,214	141	4	414	410
7	2021	54,508	141	8	416	408
8	2022	54,801	140	12	418	406
9	2023	55,095	140	16	419	403
10-year Goal	2024	55,388	140	20	421	401

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Euless's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	54,219	16.40	12	257	245
2	2016	54,218	15.80	24	257	234
3	2017	54,217	15.20	36	257	222
4	2018	54,216	14.60	47	257	210
5-year Goal	2019	54,215	14.00	59	257	198
6	2020	54,214	13.96	60	257	197
7	2021	54,508	13.92	61	259	197
8	2022	54,801	13.88	62	260	198
9	2023	55,095	13.84	64	261	198
10-year Goal	2024	55,388	13.80	65	263	198

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 257 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 9.0% increase in 2015
        ii. 10.0% increase in 2016
    b. Estimated customer demand reduction of 3.8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**
    a. Sensus Analytics Customer Portal
    b. Estimated savings of 43 MG in 2016
        i. Specific utility results may vary based on portal features and notifications
    c. Assumes 20% of residential customers are using and saving water due to the portal (Westin Engineering, 2015)
    d. Assumes customers save 10% of total annual use due to the portal

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

[17] Correspondence with utility staff.

[18] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

e. Residential customers' use makes up approximately 75% of all retail customers' use based on utility profile information submitted to the TWDB
f. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.49% of total demand
g. Savings are assumed to increase along with demand as connections increase each year[19]

6. Save Water Co. Commercial, Multi-family and Hotel Programs[20]

a. Project initiated in service area in 2015
b. Save Water completed work on 120 multi-family units in 2015
c. Average monthly savings of 162,738 gallons
d. Annualized savings of 1.95 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.
[20] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	AMI with Customer Portal	Save Water Co. Program	TOTAL SAVINGS
2012				0
2013				0
2014				0
2015	52	43	2	97
2016	110	43	2	155
2017	110	43	2	156
2018	111	43	2	156
2019	111	43	2	156
2020	111	44	2	157
2021	111	44	2	157
2022	112	44	2	158
2023	112	44	2	158
2024	112	44	2	158
2025	113	44	2	159
2026	113	44	2	159
2027	113	44	2	160
2028	114	45	2	160
2029	114	45	2	160
2030	114	45	2	161
2031	114	45	2	160
2032	114	45	2	160
2033	113	44	2	160
2034	113	44	2	160
2035	113	44	2	159
2036	113	44	2	159
2037	113	44	2	159
2038	112	44	2	158
2039	112	44	2	158
2040	112	44	2	158
2041	112	44	2	157
2042	112	44	2	157
2043	111	44	2	157
2044	111	44	2	157
2045	111	44	2	157
2046	111	44	2	157
2047	111	44	2	156
2048	111	43	2	156
2049	111	43	2	156
2050	111	43	2	156
2051	111	43	2	156
2052	111	43	2	156
2053	111	43	2	156
2054	111	43	2	156
2055	110	43	2	156
2056	110	43	2	156
2057	110	43	2	156
2058	110	43	2	156
2059	110	43	2	156
2060	110	43	2	156
2061	110	43	2	156
2062	110	43	2	156
2063	110	43	2	156
2064	110	43	2	156
2065	110	43	2	156
2066	110	43	2	156
2067	110	43	2	156
2068	110	43	2	156
2069	110	43	2	156
2070	110	43	2	156

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	54,219	4.00	257
2016	54,218	4.00	257
2017	54,217	4.00	257
2018	54,216	4.00	257
2019	54,215	4.00	257
2020	54,214	4.00	257
2021	54,508	4.00	259
2022	54,801	4.00	260
2023	55,095	4.00	261
2024	55,388	4.00	263

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    i. Average Region C savings
    ii. Specific percentage of outdoor usage unknown for your utility at this time
  b. Savings could be 110 MG per year with current demand.
  c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	155	257	412	110	34	8	43	480
2017	156	257	413	110	34	10	44	479
2018	156	257	413	111	41	11	53	471
2019	156	257	414	111	48	13	61	463
2020	157	257	414	111	62	15	77	449
2021	157	259	416	111	66	15	80	447
2022	158	260	418	112	69	15	84	445
2023	158	261	419	112	73	15	88	444
2024	158	263	421	112	77	15	91	442
2025	159	264	423	113	81	15	95	440
2026	159	266	425	113	84	15	99	439
2027	160	267	427	113	88	15	103	437
2028	160	268	428	114	92	15	106	436
2029	160	270	430	114	95	15	110	434
2030	161	271	432	114	99	15	114	432
2031	160	271	432	114	100	13	113	433
2032	160	271	431	114	101	12	112	433
2033	160	271	431	113	101	10	112	433
2034	160	271	431	113	102	9	111	433
2035	159	271	430	113	103	7	110	433
2036	159	271	430	113	104	6	110	433
2037	159	271	430	113	105	4	109	433
2038	158	271	429	112	106	3	108	433
2039	158	271	429	112	106	1	108	433
2040	158	271	429	112	107	0	107	433

2. Rain Barrels

   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Farmers Branch Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Farmers Branch's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Farmers Branch's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Farmers Branch's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Farmers Branch with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

---

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	97	215	312	19	12	31	281
2016	158	212	370	23	15	39	331
2017	159	209	368	23	18	42	326
2018	159	207	366	28	21	49	316
2019	160	204	364	33	24	57	307
2020	160	201	362	42	27	69	292
2021	161	202	364	45	30	75	288
2022	162	204	365	48	33	81	284
2023	162	205	367	51	36	87	280
2024	163	206	369	54	38	93	276
2025	164	207	371	58	41	99	273
2026	164	209	373	61	44	104	269
2027	165	210	375	64	47	110	265
2028	166	211	377	67	49	116	261
2029	166	212	379	70	52	122	257
2030	167	214	381	73	55	128	253
2031	168	215	383	76	53	130	253
2032	168	216	385	79	52	131	253
2033	169	217	387	82	51	133	253
2034	170	219	389	85	50	135	253
2035	171	220	391	89	48	137	254
2036	171	221	393	92	47	139	254
2037	172	223	395	95	46	141	254
2038	173	224	396	98	45	142	254
2039	173	225	398	101	43	144	254
2040	174	226	400	104	42	146	254
2041	175	228	403	106	42	148	255
2042	176	229	405	108	42	150	255
2043	177	231	407	109	43	152	255
2044	178	232	409	111	43	154	255
2045	178	233	412	113	43	156	255
2046	179	235	414	115	43	158	256
2047	180	236	416	117	44	160	256
2048	181	237	418	118	44	162	256
2049	182	239	421	120	44	164	256
2050	183	240	423	122	44	166	257
2051	184	242	425	124	45	169	257
2052	184	243	427	126	45	171	257
2053	185	244	430	128	45	173	257
2054	186	246	432	130	45	175	257
2055	187	247	434	132	46	178	257
2056	188	248	436	134	46	180	256
2057	189	250	439	136	46	182	256
2058	190	251	441	138	46	184	256
2059	191	252	443	140	47	187	256
2060	192	254	445	142	47	189	256
2061	193	255	448	144	47	191	256
2062	193	256	450	146	47	194	256
2063	194	258	452	148	48	196	256
2064	195	259	454	150	48	198	256
2065	196	261	457	153	48	201	256
2066	197	262	459	155	48	203	256
2067	198	263	461	157	49	205	256
2068	199	265	464	159	49	208	256
2069	200	266	466	161	49	210	256
2070	201	267	468	163	49	212	256

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Farmers Branch's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	283	0	0	0
1	2015	32,689	282	7	312	305
2	2016	32,274	282	14	370	356
3	2017	31,859	281	21	368	347
4	2018	31,443	281	28	366	338
5-year Goal	2019	31,028	280	34	364	330
6	2020	30,613	279	40	362	321
7	2021	30,803	279	47	364	316
8	2022	30,992	278	54	365	311
9	2023	31,182	278	61	367	306
10-year Goal	2024	31,371	277	69	369	301

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Farmers Branch's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	54.00	0	0	0
1	2015	32,689	53.60	5	215	210
2	2016	32,274	53.20	9	212	203
3	2017	31,859	52.80	14	209	195
4	2018	31,443	52.40	18	207	188
5-year Goal	2019	31,028	52.00	23	204	181
6	2020	30,613	51.80	25	201	177
7	2021	30,803	51.60	27	202	175
8	2022	30,992	51.40	29	204	174
9	2023	31,182	51.20	32	205	173
10-year Goal	2024	31,371	51.00	34	206	172

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
   a. Savings of 215 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[16]
      i. 15.0% increase in 2015
      ii. 9.0% increase in 2016
   b. Estimated customer demand reduction of 4.8%
   c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Save Water Co. Commercial, Multi-family and Hotel Programs[18]

a. Project initiated in service area in 2014
b. Save Water completed work on 520 multi-family units in 2016
c. Average monthly savings of 1,588,361 gallons
d. Annualized savings of 19 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[18] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	Save Water Co. Program	TOTAL SAVINGS
2012			0
2013			0
2014		11	11
2015	86	11	97
2016	139	19	158
2017	139	19	159
2018	140	19	159
2019	141	19	160
2020	141	19	160
2021	142	19	161
2022	143	19	162
2023	143	19	162
2024	144	19	163
2025	145	19	164
2026	145	19	164
2027	146	19	165
2028	147	19	166
2029	147	19	166
2030	148	19	167
2031	149	19	168
2032	149	19	168
2033	150	19	169
2034	151	19	170
2035	151	19	171
2036	152	19	171
2037	153	19	172
2038	154	19	173
2039	154	19	173
2040	155	19	174
2041	156	19	175
2042	157	19	176
2043	158	19	177
2044	158	19	178
2045	159	19	178
2046	160	19	179
2047	161	19	180
2048	162	19	181
2049	163	19	182
2050	164	19	183
2051	164	19	184
2052	165	19	184
2053	166	19	185
2054	167	19	186
2055	168	19	187
2056	169	19	188
2057	170	19	189
2058	171	19	190
2059	172	19	191
2060	173	19	192
2061	173	19	193
2062	174	19	193
2063	175	19	194
2064	176	19	195
2065	177	19	196
2066	178	19	197
2067	179	19	198
2068	180	19	199
2069	181	19	200
2070	182	19	201

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	54.00	0
2015	32,689	36.00	215
2016	32,274	36.00	212
2017	31,859	36.00	209
2018	31,443	36.00	207
2019	31,028	36.00	204
2020	30,613	36.00	201
2021	30,803	36.00	202
2022	30,992	36.00	204
2023	31,182	36.00	205
2024	31,371	36.00	206

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8.21% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 237 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	158	212	370	237	23	15	39	569
2017	159	209	368	239	23	18	42	565
2018	159	207	366	240	28	21	49	556
2019	160	204	364	241	33	24	57	547
2020	160	201	362	242	42	27	69	534
2021	161	202	364	243	45	30	75	531
2022	162	204	365	244	48	33	81	528
2023	162	205	367	245	51	36	87	526
2024	163	206	369	247	54	38	93	524
2025	164	207	371	249	58	41	99	521
2026	164	209	373	249	61	44	104	517
2027	165	210	375	250	64	47	110	514
2028	166	211	377	251	67	49	116	512
2029	166	212	379	252	70	52	122	509
2030	167	214	381	253	73	55	128	506
2031	168	215	383	254	76	53	130	507
2032	168	216	385	255	79	52	131	509
2033	169	217	387	257	82	51	133	510
2034	170	219	389	258	85	50	135	511
2035	171	220	391	259	89	48	137	513
2036	171	221	393	260	92	47	139	514
2037	172	223	395	262	237	46	283	373
2038	173	224	396	263	98	45	142	517
2039	173	225	398	264	101	43	144	518
2040	174	226	400	265	104	42	146	520

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	158	212	370	39	23	15	39	370
2017	159	209	368	39	23	18	42	365
2018	159	207	366	39	28	21	49	356
2019	160	204	364	39	33	24	57	346
2020	160	201	362	39	42	27	69	332
2021	161	202	364	40	45	30	75	328
2022	162	204	365	40	48	33	81	324
2023	162	205	367	40	51	36	87	320
2024	163	206	369	40	54	38	93	317
2025	164	207	371	40	58	41	99	313
2026	164	209	373	41	61	44	104	309
2027	165	210	375	41	64	47	110	305
2028	166	211	377	41	67	49	116	302
2029	166	212	379	41	70	52	122	298
2030	167	214	381	41	73	55	128	294
2031	168	215	383	42	76	53	130	295
2032	168	216	385	42	79	52	131	295
2033	169	217	387	42	82	51	133	295
2034	170	219	389	42	85	50	135	296
2035	171	220	391	42	89	48	137	296
2036	171	221	393	42	92	47	139	296
2037	172	223	395	43	95	46	141	297
2038	173	224	396	43	98	45	142	297
2039	173	225	398	43	101	43	144	297
2040	174	226	400	43	104	42	146	298

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Forney Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Forney's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Forney's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Forney's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Forney with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	29	0	29	2	2	4	25
2016	39	0	39	2	3	5	34
2017	40	0	40	2	3	5	34
2018	40	0	40	2	4	6	34
2019	41	0	41	3	5	7	34
2020	42	0	42	4	5	9	33
2021	42	0	42	4	5	9	33
2022	43	0	43	4	5	10	33
2023	44	0	44	5	5	10	33
2024	44	0	44	5	5	11	34
2025	45	0	45	6	5	11	34
2026	46	0	46	6	5	12	34
2027	46	0	46	7	5	12	34
2028	47	0	47	7	5	12	35
2029	48	0	48	8	5	13	35
2030	48	0	48	8	5	13	35
2031	50	0	50	9	5	14	36
2032	51	0	51	10	4	14	37
2033	53	0	53	10	4	14	39
2034	54	0	54	11	3	14	40
2035	55	0	55	12	3	15	41
2036	57	0	57	13	2	15	42
2037	58	0	58	13	2	15	43
2038	60	0	60	14	1	15	45
2039	61	0	61	15	1	15	46
2040	63	0	63	16	0	16	47
2041	64	0	64	17	0	17	47
2042	65	0	65	18	0	18	48
2043	67	0	67	19	0	19	48
2044	68	0	68	20	0	20	48
2045	69	0	69	21	0	21	49
2046	71	0	71	22	0	22	49
2047	72	0	72	22	0	22	49
2048	73	0	73	23	0	23	50
2049	75	0	75	24	0	24	50
2050	76	0	76	25	0	25	50
2051	79	0	79	27	0	27	52
2052	83	0	83	29	0	29	53
2053	86	0	86	31	0	31	55
2054	89	0	89	34	0	34	56
2055	93	0	93	36	0	36	57
2056	96	0	96	38	0	38	59
2057	100	0	100	40	0	40	60
2058	103	0	103	42	0	42	61
2059	106	0	106	44	0	44	63
2060	110	0	110	46	0	46	64
2061	114	0	114	48	0	48	65
2062	117	0	117	51	0	51	66
2063	121	0	121	54	0	54	67
2064	124	0	124	57	0	57	68
2065	128	0	128	59	0	59	69
2066	132	0	132	62	0	62	70
2067	135	0	135	65	0	65	70
2068	139	0	139	68	0	68	71
2069	143	0	143	71	0	71	72
2070	146	0	146	73	0	73	73

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Forney's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	104	0	0	0
1	2015	18,418	103	9	29	19
2	2016	19,141	101	20	39	19
3	2017	19,864	100	30	40	9
4	2018	20,587	98	42	40	(2)
5-year Goal	2019	21,310	97	54	41	(14)
6	2020	22,033	96	63	42	(21)
7	2021	22,430	95	70	42	(28)
8	2022	22,826	95	78	43	(35)
9	2023	23,223	94	86	44	(43)
10-year Goal	2024	23,620	93	95	44	(51)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Forney's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	18,418	15.40	17	0	(17)
2	2016	19,141	12.80	36	0	(36)
3	2017	19,864	10.20	57	0	(57)
4	2018	20,587	7.60	78	0	(78)
5-year Goal	2019	21,310	5.00	101	0	(101)
6	2020	22,033	4.40	109	0	(109)
7	2021	22,430	3.80	116	0	(116)
8	2022	22,826	3.20	123	0	(123)
9	2023	23,223	2.60	131	0	(131)
10-year Goal	2024	23,620	2.00	138	0	(138)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 15% increase in 2013
        ii. 5% increase in 2016
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013	28.0	28
2014	28.2	28
2015	28.7	29
2016	38.9	39
2017	39.6	40
2018	40.3	40
2019	40.9	41
2020	41.6	42
2021	42.3	42
2022	42.9	43
2023	43.6	44
2024	44.3	44
2025	45.0	45
2026	45.6	46
2027	46.3	46
2028	47.0	47
2029	47.7	48
2030	48.3	48
2031	49.8	50
2032	51.2	51
2033	52.6	53
2034	54.0	54
2035	55.5	55
2036	56.9	57
2037	58.3	58
2038	59.8	60
2039	61.2	61
2040	62.6	63
2041	63.9	64
2042	65.3	65
2043	66.6	67
2044	67.9	68
2045	69.2	69
2046	70.5	71
2047	71.9	72
2048	73.2	73
2049	74.5	75
2050	75.8	76
2051	79.2	79
2052	82.6	83
2053	86.0	86
2054	89.4	89
2055	92.8	93
2056	96.3	96
2057	99.7	100
2058	103.1	103
2059	106.5	106
2060	109.9	110
2061	113.5	114
2062	117.2	117
2063	120.8	121
2064	124.5	124
2065	128.1	128
2066	131.8	132
2067	135.4	135
2068	139.1	139
2069	142.7	143
2070	146.4	146

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	18,418	18.00	0
2016	19,141	18.00	0
2017	19,864	18.00	0
2018	20,587	18.00	0
2019	21,310	18.00	0
2020	22,033	18.00	0
2021	22,430	18.00	0
2022	22,826	18.00	0
2023	23,223	18.00	0
2024	23,620	18.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 78 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	39	0	39	78	2	3	5	112
2017	40	0	40	79	2	3	5	113
2018	40	0	40	81	2	4	6	114
2019	41	0	41	82	3	5	7	115
2020	42	0	42	83	4	5	9	116
2021	42	0	42	85	4	5	9	118
2022	43	0	43	86	4	5	10	119
2023	44	0	44	87	5	5	10	121
2024	44	0	44	89	5	5	11	122
2025	45	0	45	90	6	5	11	124
2026	46	0	46	91	6	5	12	125
2027	46	0	46	93	7	5	12	127
2028	47	0	47	94	7	5	12	128
2029	48	0	48	95	8	5	13	130
2030	48	0	48	97	8	5	13	132
2031	50	0	50	100	9	5	14	136
2032	51	0	51	102	10	4	14	140
2033	53	0	53	105	10	4	14	144
2034	54	0	54	108	11	3	14	148
2035	55	0	55	111	12	3	15	152
2036	57	0	57	114	13	2	15	156
2037	58	0	58	117	13	2	15	160
2038	60	0	60	120	14	1	15	164
2039	61	0	61	122	15	1	15	168
2040	63	0	63	125	16	0	16	172

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	39	0	39	13	2	3	5	47
2017	40	0	40	13	2	3	5	47
2018	40	0	40	13	2	4	6	47
2019	41	0	41	14	3	5	7	47
2020	42	0	42	14	4	5	9	47
2021	42	0	42	14	4	5	9	47
2022	43	0	43	14	4	5	10	48
2023	44	0	44	15	5	5	10	48
2024	44	0	44	15	5	5	11	49
2025	45	0	45	15	6	5	11	49
2026	46	0	46	15	6	5	12	49
2027	46	0	46	16	7	5	12	50
2028	47	0	47	16	7	5	12	50
2029	48	0	48	16	8	5	13	51
2030	48	0	48	16	8	5	13	51
2031	50	0	50	17	9	5	14	53
2032	51	0	51	17	10	4	14	55
2033	53	0	53	18	10	4	14	56
2034	54	0	54	18	11	3	14	58
2035	55	0	55	19	12	3	15	60
2036	57	0	57	19	13	2	15	61
2037	58	0	58	20	13	2	15	63
2038	60	0	60	20	14	1	15	65
2039	61	0	61	20	15	1	15	66
2040	63	0	63	21	16	0	16	68

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Ft. Worth Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Ft. Worth's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Ft. Worth's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Ft. Worth's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Ft. Worth with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4,387	2,433	6,820	790	2,720	3,510	3,310
2016	4,647	2,504	7,151	988	3,399	4,387	2,763
2017	4,768	2,574	7,342	988	4,079	5,067	2,275
2018	4,876	2,645	7,521	1,185	4,759	5,945	1,576
2019	4,953	2,715	7,668	1,383	5,439	6,822	846
2020	5,060	2,786	7,846	1,778	6,119	7,897	(51)
2021	5,168	2,859	8,027	1,887	6,178	8,065	(38)
2022	5,275	2,933	8,209	1,995	6,237	8,232	(23)
2023	5,384	3,007	8,391	2,104	6,296	8,399	(9)
2024	5,493	3,081	8,574	2,212	6,355	8,567	7
2025	5,603	3,155	8,758	2,321	6,414	8,734	23
2026	5,713	3,229	8,942	2,429	6,472	8,902	41
2027	5,825	3,303	9,127	2,538	6,531	9,069	58
2028	5,936	3,376	9,313	2,646	6,590	9,236	76
2029	6,048	3,450	9,498	2,755	6,649	9,404	94
2030	6,159	3,524	9,683	2,863	6,708	9,571	112
2031	6,287	3,607	9,894	2,983	6,316	9,298	596
2032	6,414	3,690	10,104	3,102	5,923	9,025	1,079
2033	6,542	3,773	10,315	3,222	5,531	8,752	1,562
2034	6,670	3,856	10,525	3,341	5,138	8,479	2,046
2035	6,797	3,939	10,736	3,461	4,746	8,206	2,529
2036	6,925	4,022	10,946	3,580	4,353	7,934	3,013
2037	7,052	4,104	11,157	3,700	3,961	7,661	3,496
2038	7,180	4,187	11,368	3,820	3,568	7,388	3,980
2039	7,308	4,270	11,578	3,939	3,176	7,115	4,463
2040	7,435	4,353	11,789	4,059	2,783	6,842	4,947
2041	7,512	4,402	11,914	4,124	2,711	6,834	5,080
2042	7,588	4,452	12,039	4,189	2,638	6,827	5,212
2043	7,664	4,501	12,165	4,254	2,565	6,820	5,345
2044	7,740	4,550	12,290	4,320	2,492	6,812	5,478
2045	7,816	4,600	12,415	4,385	2,420	6,805	5,611
2046	7,892	4,649	12,541	4,450	2,347	6,797	5,744
2047	7,968	4,698	12,666	4,515	2,274	6,790	5,876
2048	8,044	4,748	12,792	4,580	2,202	6,782	6,009
2049	8,120	4,797	12,917	4,646	2,129	6,775	6,142
2050	8,196	4,846	13,042	4,711	2,056	6,767	6,275
2051	8,264	4,889	13,153	4,788	1,963	6,751	6,402
2052	8,332	4,932	13,264	4,866	1,869	6,734	6,529
2053	8,400	4,975	13,374	4,943	1,775	6,718	6,656
2054	8,467	5,018	13,485	5,020	1,681	6,701	6,784
2055	8,535	5,061	13,596	5,098	1,587	6,685	6,911
2056	8,603	5,103	13,706	5,175	1,493	6,669	7,038
2057	8,671	5,146	13,817	5,253	1,399	6,652	7,165
2058	8,739	5,189	13,928	5,330	1,306	6,636	7,292
2059	8,807	5,232	14,039	5,407	1,212	6,619	7,419
2060	8,874	5,275	14,149	5,485	1,118	6,603	7,547
2061	8,943	5,318	14,261	5,569	1,006	6,575	7,686
2062	9,011	5,361	14,372	5,653	894	6,547	7,825
2063	9,080	5,404	14,483	5,737	782	6,520	7,964
2064	9,148	5,446	14,594	5,821	671	6,492	8,103
2065	9,217	5,489	14,706	5,905	559	6,464	8,242
2066	9,285	5,532	14,817	5,989	447	6,436	8,381
2067	9,353	5,575	14,928	6,073	335	6,409	8,520
2068	9,422	5,618	15,040	6,157	224	6,381	8,659
2069	9,490	5,661	15,151	6,241	112	6,353	8,798
2070	9,559	5,704	15,262	6,325	0	6,325	8,937

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Ft. Worth's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	171	0	0	0
1	2016	857,449	169	689	7,151	6,462
2	2017	881,580	167	1,416	7,342	5,926
3	2018	905,710	164	2,182	7,521	5,339
4	2019	929,841	162	2,987	7,668	4,682
5-year Goal	2020	953,971	160	3,830	7,846	4,016
6	2021	979,266	158	4,504	8,027	3,523
7	2022	1,004,561	157	5,207	8,209	3,002
8	2023	1,029,856	155	5,939	8,391	2,452
9	2024	1,055,151	154	6,701	8,574	1,873
10-year Goal	2025	1,080,446	152	7,493	8,758	1,265

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Ft. Worth's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	38.00	0	0	0
1	2016	857,449	35.40	814	2,504	1,690
2	2017	881,580	32.80	1,673	2,574	901
3	2018	905,710	30.20	2,579	2,645	66
4	2019	929,841	27.60	3,530	2,715	(815)
5-year Goal	2020	953,971	25.00	4,527	2,786	(1,741)
6	2021	979,266	24.60	4,790	2,859	(1,930)
7	2022	1,004,561	24.20	5,060	2,933	(2,127)
8	2023	1,029,856	23.80	5,338	3,007	(2,331)
9	2024	1,055,151	23.40	5,623	3,081	(2,542)
10-year Goal	2025	1,080,446	23.00	5,915	3,155	(2,761)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 30 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 12.2% increase in 2016
        ii. 1.3% increase in 2017
    b. Estimated customer demand reduction of 2.7%
    c. Savings are cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.37% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Outdoor Landscape Evaluations (SF) — W.I.S.E. Guys**
    a. 1,085 outdoor evaluations performed since 2012
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
    a. 6 projects initiated in service area in 2015
    b. Save Water completed work on 911 multi-family units in 2015.
    c. Average monthly savings of 1,606,950 gallons
    d. Annualized savings of 19 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

9. **SmartFlush High Efficiency (HE) Toilet Replacement Program (SF)**
    a. 37,914 toilets replaced since 2009
    b. Average of 4,740 replaced annually
    c. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    d. Savings carry on indefinitely because replacement toilet will be as efficient

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

10. SmartWater Audits (ICI)

a. Average of 36 audits performed each year
b. Average of 104,395 gallons saved per audit
c. Approximated 10-year useful life on savings
    i. 6 years of full savings
    ii. 20% decay rate in last four years to last 10 years total

11. Kitchen Pre-rinse Spray Valves (ICI)

a. 1,090 replaced valves
b. Estimated savings of 28,280 gallons per year per valve (CUWCC, 2004; SWB, 2007)
c. 10-year useful life assumed

12. Efficient Irrigation Nozzles (SF)

a. Average estimated savings of 330 gallons per year per nozzle
b. 5-year useful life
c. Various amounts distributed each year
    i. Figures provided by utility staff

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Save Water Co. Program	SmartFlush Toilet Replacement	SmartWater Audit (ICI)	2x Watering Ordinance	Indoor/Outdoor Surveys (MF)	W.I.S.E. Guys Program	Pre-Rinse Spray Valves (ICI)	Irrigation Nozzles (SF)	Water Rate Increases	TOTAL SAVINGS
2009		49					30.8			80
2010		98					30.8			129
2011		148	3.8				30.8			182
2012		197	7.5	3,642		0.4	30.8	0.003		3,878
2013		246	11.3	3,751		1.6	30.8	0.018		4,040
2014		295	15.0	3,859		2.5	30.8	0.031		4,203
2015	19	345	18.8	3,967		5.6	30.8	0.079		4,387
2016	19	394	22.5	4,076		6.4	30.8	0.107	98	4,647
2017	19	394	21.8	4,184		4.6	30.8	0.103	113	4,768
2018	19	394	20.3	4,293		3.0	30.8	0.089	116	4,876
2019	19	394	18.0	4,401		1.6		0.075	119	4,953
2020	19	394	15.0	4,510		0.4		0.028	122	5,060
2021	19	394	11.3	4,618					125	5,168
2022	19	394	7.5	4,727					128	5,275
2023	19	394	4.5	4,835					131	5,384
2024	19	394	2.3	4,944					133	5,493
2025	19	394	0.8	5,052					136	5,603
2026	19	394		5,161					139	5,713
2027	19	394		5,269					142	5,825
2028	19	394		5,378					145	5,936
2029	19	394		5,486					148	6,048
2030	19	394		5,595					151	6,159
2031	19	394		5,719					154	6,287
2032	19	394		5,843					158	6,414
2033	19	394		5,967					161	6,542
2034	19	394		6,092					164	6,670
2035	19	394		6,216					168	6,797
2036	19	394		6,340					171	6,925
2037	19	394		6,465					175	7,052
2038	19	394		6,589					178	7,180
2039	19	394		6,713					181	7,308
2040	19	394		6,838					185	7,435
2041	19	394		6,912					187	7,512
2042	19	394		6,986					189	7,588
2043	19	394		7,060					191	7,664
2044	19	394		7,134					193	7,740
2045	19	394		7,208					195	7,816
2046	19	394		7,282					197	7,892
2047	19	394		7,356					199	7,968
2048	19	394		7,430					201	8,044
2049	19	394		7,504					203	8,120
2050	19	394		7,578					205	8,196
2051	19	394		7,644					206	8,264
2052	19	394		7,710					208	8,332
2053	19	394		7,776					210	8,400
2054	19	394		7,842					212	8,467
2055	19	394		7,908					214	8,535
2056	19	394		7,974					215	8,603
2057	19	394		8,040					217	8,671
2058	19	394		8,107					219	8,739
2059	19	394		8,173					221	8,807
2060	19	394		8,239					222	8,874
2061	19	394		8,305					224	8,943
2062	19	394		8,372					226	9,011
2063	19	394		8,439					228	9,080
2064	19	394		8,505					230	9,148
2065	19	394		8,572					231	9,217
2066	19	394		8,638					233	9,285
2067	19	394		8,705					235	9,353
2068	19	394		8,772					237	9,422
2069	19	394		8,838					239	9,490
2070	19	394		8,905					240	9,559

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	38.00	0
2015	833,319	30.00	2,433
2016	857,449	30.00	2,504
2017	881,580	30.00	2,574
2018	905,710	30.00	2,645
2019	929,841	30.00	2,715
2020	953,971	30.00	2,786
2021	979,266	30.00	2,859
2022	1,004,561	30.00	2,933
2023	1,029,856	30.00	3,007
2024	1,055,151	30.00	3,081

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4,647	2,504	7,151	741	988	3,399	4,387	3,504
2017	4,768	2,574	7,342	761	988	4,079	5,067	3,036
2018	4,876	2,645	7,521	781	1,185	4,759	5,945	2,357
2019	4,953	2,715	7,668	800	1,383	5,439	6,822	1,646
2020	5,060	2,786	7,846	820	1,778	6,119	7,897	769
2021	5,168	2,859	8,027	840	1,887	6,178	8,065	802
2022	5,275	2,933	8,209	859	1,995	6,237	8,232	836
2023	5,384	3,007	8,391	879	2,104	6,296	8,399	871
2024	5,493	3,081	8,574	899	2,212	6,355	8,567	906
2025	5,603	3,155	8,758	919	2,321	6,414	8,734	942
2026	5,713	3,229	8,942	938	2,429	6,472	8,902	979
2027	5,825	3,303	9,127	958	2,538	6,531	9,069	1,016
2028	5,936	3,376	9,313	978	2,646	6,590	9,236	1,054
2029	6,048	3,450	9,498	997	2,755	6,649	9,404	1,092
2030	6,159	3,524	9,683	1017	2,863	6,708	9,571	1,129
2031	6,287	3,607	9,894	1040	2,983	6,316	9,298	1,635
2032	6,414	3,690	10,104	1062	3,102	5,923	9,025	2,141
2033	6,542	3,773	10,315	1085	3,222	5,531	8,752	2,647
2034	6,670	3,856	10,525	1108	3,341	5,138	8,479	3,154
2035	6,797	3,939	10,736	1130	3,461	4,746	8,206	3,660
2036	6,925	4,022	10,946	1153	3,580	4,353	7,934	4,166
2037	7,052	4,104	11,157	1175	3,700	3,961	7,661	4,672
2038	7,180	4,187	11,368	1198	3,820	3,568	7,388	5,178
2039	7,308	4,270	11,578	1221	3,939	3,176	7,115	5,684
2040	7,435	4,353	11,789	1243	4,059	2,783	6,842	6,190

Statewide Water Conservation Quantification Project
City of Frisco Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Frisco's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Frisco's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Frisco's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Frisco with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,301	896	2,197	220	30	251	1,946
2016	1,402	915	2,317	276	38	313	2,003
2017	1,423	935	2,358	276	45	321	2,037
2018	1,449	954	2,403	331	53	383	2,020
2019	1,478	974	2,452	386	60	446	2,006
2020	1,514	994	2,507	496	68	564	1,943
2021	1,554	1,025	2,579	526	68	594	1,986
2022	1,601	1,057	2,658	556	68	624	2,034
2023	1,647	1,088	2,736	586	68	653	2,082
2024	1,693	1,120	2,813	615	68	683	2,130
2025	1,739	1,151	2,891	645	68	713	2,178
2026	1,786	1,183	2,968	675	68	743	2,225
2027	1,833	1,214	3,047	705	68	773	2,274
2028	1,880	1,246	3,126	735	68	803	2,323
2029	1,927	1,277	3,205	765	68	832	2,372
2030	1,975	1,309	3,283	795	68	862	2,421
2031	2,020	1,340	3,360	832	61	893	2,468
2032	2,066	1,372	3,437	868	54	923	2,515
2033	2,111	1,403	3,515	905	47	953	2,562
2034	2,157	1,435	3,592	942	41	983	2,609
2035	2,202	1,466	3,669	979	34	1,013	2,655
2036	2,248	1,498	3,746	1,016	27	1,043	2,702
2037	2,293	1,529	3,823	1,053	20	1,074	2,749
2038	2,339	1,561	3,900	1,090	14	1,104	2,796
2039	2,385	1,592	3,977	1,127	7	1,134	2,843
2040	2,430	1,624	4,054	1,164	0	1,164	2,890
2041	2,430	1,624	4,054	1,171	0	1,171	2,882
2042	2,430	1,624	4,054	1,179	0	1,179	2,875
2043	2,429	1,624	4,053	1,186	0	1,186	2,868
2044	2,429	1,624	4,053	1,193	0	1,193	2,860
2045	2,429	1,624	4,053	1,200	0	1,200	2,853
2046	2,429	1,624	4,053	1,207	0	1,207	2,845
2047	2,428	1,624	4,052	1,215	0	1,215	2,838
2048	2,428	1,624	4,052	1,222	0	1,222	2,830
2049	2,428	1,624	4,052	1,229	0	1,229	2,823
2050	2,428	1,624	4,052	1,236	0	1,236	2,816
2051	2,428	1,624	4,052	1,243	0	1,243	2,808
2052	2,427	1,624	4,051	1,251	0	1,251	2,801
2053	2,427	1,624	4,051	1,258	0	1,258	2,793
2054	2,427	1,624	4,051	1,265	0	1,265	2,786
2055	2,427	1,624	4,051	1,272	0	1,272	2,778
2056	2,427	1,624	4,051	1,280	0	1,280	2,771
2057	2,427	1,624	4,051	1,287	0	1,287	2,764
2058	2,427	1,624	4,050	1,294	0	1,294	2,756
2059	2,426	1,624	4,050	1,302	0	1,302	2,749
2060	2,426	1,624	4,050	1,309	0	1,309	2,741
2061	2,426	1,624	4,050	1,316	0	1,316	2,734
2062	2,426	1,624	4,050	1,323	0	1,323	2,727
2063	2,426	1,624	4,050	1,331	0	1,331	2,720
2064	2,426	1,624	4,050	1,338	0	1,338	2,712
2065	2,426	1,624	4,050	1,345	0	1,345	2,705
2066	2,426	1,624	4,050	1,352	0	1,352	2,698
2067	2,426	1,624	4,050	1,359	0	1,359	2,690
2068	2,426	1,624	4,050	1,367	0	1,367	2,683
2069	2,426	1,624	4,050	1,374	0	1,374	2,676
2070	2,426	1,624	4,050	1,381	0	1,381	2,669

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Frisco's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	215	0	0	0
1	2015	154,407	213	124	2,197	2,073
2	2016	157,791	211	253	2,317	2,063
3	2017	161,175	208	388	2,358	1,970
4	2018	164,558	206	529	2,403	1,875
5-year Goal	2019	167,942	204	674	2,452	1,778
6	2020	171,326	202	813	2,507	1,694
7	2021	176,760	200	968	2,579	1,612
8	2022	182,193	198	1,131	2,658	1,527
9	2023	187,627	196	1,301	2,736	1,434
10-year Goal	2024	193,061	194	1,480	2,813	1,333

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Frisco's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	24.34	0	0	0
1	2015	154,407	24.27	4	896	892
2	2016	157,791	24.20	8	915	907
3	2017	161,175	24.14	12	935	923
4	2018	164,558	24.07	16	954	938
5-year Goal	2019	167,942	24.00	21	974	953
6	2020	171,326	23.80	34	994	960
7	2021	176,760	23.60	48	1,025	977
8	2022	182,193	23.40	63	1,057	994
9	2023	187,627	23.20	78	1,088	1,010
10-year Goal	2024	193,061	23.00	94	1,120	1,025

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 896 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.0% increase in 2015
        ii. 2.0% increase in 2016
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 9.68% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. Outdoor Landscape Evaluations (SF)

a. 18,800 outdoor evaluations performed since 2010
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. Rain Barrels

a. 1,276 50-gallon barrels rebated, sold, or distributed from 2014 – 2016
b. In Region C, estimated savings of 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
c. Estimated 10-year useful life for most barrels

9. Showerhead Distribution (SF)

a. Approximately 25 showerheads replaced per year from 2009 – 2016
b. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
c. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

10. Irrigation Controller Rebates (SF)

a. 60 rebates issued per year since 2009
b. Quantified through 2016
c. Estimated savings of 11,340 gallons per year per controller
d. Used EPA WaterSense Water Budget Tool Formula[19] with 4,000 sq. ft. as basis for landscape hydrozone
e. Savings assumed to last 10 years with no decay rate

[19] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Rain Barrels	Outdoor Audits	Low Flow Showerheads (SF)	Irrigation Controllers (SF)	Water Rate Increases	TOTAL SAVINGS
2009	858			0.1	0.7		859
2010	900		9.5	0.1	1.4		911
2011	941		20.4	0.2	2.0		964
2012	982		37.3	0.2	2.7		1,022
2013	1,023		49.4	0.3	3.4		1,076
2014	1,065	0.7	65.7	0.3	4.1		1,135
2015	1,106	1.1	74.9	0.4	4.8	114	1,301
2016	1,147	1.3	81.3	0.4	5.4	166	1,402
2017	1,188	1.3	55.6	0.4	5.4	172	1,423
2018	1,230	1.3	34.3	0.4	5.4	178	1,449
2019	1,271	1.3	17.1	0.4	4.8	184	1,478
2020	1,312	1.3	5.8	0.4	4.1	190	1,514
2021	1,353	1.3		0.4	3.4	196	1,554
2022	1,395	1.3		0.4	2.7	202	1,601
2023	1,436	1.3		0.4	2.0	208	1,647
2024	1,477	0.6		0.4	1.4	214	1,693
2025	1,518	0.3		0.4	0.7	220	1,739
2026	1,560			0.4		226	1,786
2027	1,601			0.4		232	1,833
2028	1,642			0.4		238	1,880
2029	1,683			0.4		243	1,927
2030	1,725			0.4		249	1,975
2031	1,765			0.4		255	2,020
2032	1,804			0.4		261	2,066
2033	1,844			0.4		267	2,111
2034	1,884			0.4		272	2,157
2035	1,924			0.4		278	2,202
2036	1,964			0.4		284	2,248
2037	2,003			0.4		290	2,293
2038	2,043			0.4		295	2,339
2039	2,083			0.4		301	2,385
2040	2,123			0.4		307	2,430
2041	2,123			0.4		307	2,430
2042	2,122			0.4		307	2,430
2043	2,122			0.4		307	2,429
2044	2,122			0.4		307	2,429
2045	2,122			0.4		307	2,429
2046	2,122			0.4		307	2,429
2047	2,121			0.4		307	2,428
2048	2,121			0.4		307	2,428
2049	2,121			0.4		307	2,428
2050	2,121			0.4		307	2,428
2051	2,121			0.4		307	2,428
2052	2,120			0.4		307	2,427
2053	2,120			0.4		307	2,427
2054	2,120			0.4		307	2,427
2055	2,120			0.4		307	2,427
2056	2,120			0.4		307	2,427
2057	2,120			0.4		307	2,427
2058	2,120			0.4		307	2,427
2059	2,119			0.4		307	2,426
2060	2,119			0.4		307	2,426
2061	2,119			0.4		307	2,426
2062	2,119			0.4		307	2,426
2063	2,119			0.4		306	2,426
2064	2,119			0.4		306	2,426
2065	2,119			0.4		306	2,426
2066	2,119			0.4		306	2,426
2067	2,119			0.4		306	2,426
2068	2,119			0.4		306	2,426
2069	2,119			0.4		306	2,426
2070	2,119			0.4		306	2,426

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	24.34	0
2015	154,407	8.45	896
2016	157,791	8.45	915
2017	161,175	8.45	935
2018	164,558	8.45	954
2019	167,942	8.45	974
2020	171,326	8.45	994
2021	176,760	8.45	1,025
2022	182,193	8.45	1,057
2023	187,627	8.45	1,088
2024	193,061	8.45	1,120

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,402	915	2,317	159	276	38	313	2,162
2017	1,423	935	2,358	165	276	45	321	2,202
2018	1,449	954	2,403	170	331	53	383	2,190
2019	1,478	974	2,452	176	386	60	446	2,182
2020	1,514	994	2,507	182	496	68	564	2,125
2021	1,554	1,025	2,579	187	526	68	594	2,173
2022	1,601	1,057	2,658	193	556	68	624	2,227
2023	1,647	1,088	2,736	199	586	68	653	2,281
2024	1,693	1,120	2,813	204	615	68	683	2,334
2025	1,739	1,151	2,891	210	645	68	713	2,388
2026	1,786	1,183	2,968	216	675	68	743	2,441
2027	1,833	1,214	3,047	222	705	68	773	2,496
2028	1,880	1,246	3,126	227	735	68	803	2,551
2029	1,927	1,277	3,205	233	765	68	832	2,605
2030	1,975	1,309	3,283	239	795	68	862	2,660
2031	2,020	1,340	3,360	244	832	61	893	2,712
2032	2,066	1,372	3,437	250	868	54	923	2,765
2033	2,111	1,403	3,515	255	905	47	953	2,817
2034	2,157	1,435	3,592	261	942	41	983	2,869
2035	2,202	1,466	3,669	266	979	34	1,013	2,922
2036	2,248	1,498	3,746	272	1,016	27	1,043	2,974
2037	2,293	1,529	3,823	277	1,053	20	1,074	3,027
2038	2,339	1,561	3,900	283	1,090	14	1,104	3,079
2039	2,385	1,592	3,977	288	1,127	7	1,134	3,131
2040	2,430	1,624	4,054	294	1,164	0	1,164	3,184

2. Employ efforts to maintain water loss volumes near baseline level or below.
3. In the future, as your utility finds water and/or wastewater service rate increases necessary, such pricing signals should continue to be effective in reducing demand.

Statewide Water Conservation Quantification Project
City of Garland Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Garland's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Garland's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Garland's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Garland with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	796	1,297	2,093	73	27	100	1,993
2016	901	1,295	2,195	91	34	125	2,070
2017	901	1,292	2,193	91	41	132	2,061
2018	901	1,290	2,191	109	48	157	2,033
2019	901	1,287	2,188	128	55	182	2,006
2020	901	1,285	2,186	164	62	226	1,961
2021	902	1,289	2,190	174	62	236	1,954
2022	902	1,293	2,195	185	62	246	1,948
2023	902	1,296	2,199	195	62	257	1,942
2024	903	1,300	2,203	206	62	267	1,936
2025	903	1,304	2,207	216	62	278	1,929
2026	903	1,308	2,211	227	62	288	1,923
2027	904	1,312	2,216	237	62	299	1,917
2028	904	1,316	2,220	247	62	309	1,911
2029	904	1,320	2,224	258	62	319	1,905
2030	905	1,324	2,228	268	62	330	1,898
2031	903	1,325	2,228	254	55	309	1,919
2032	902	1,326	2,228	239	49	288	1,940
2033	901	1,327	2,228	224	43	268	1,960
2034	900	1,328	2,227	210	37	247	1,981
2035	899	1,328	2,227	195	31	226	2,001
2036	898	1,329	2,227	181	25	205	2,022
2037	896	1,330	2,227	166	18	184	2,042
2038	895	1,331	2,227	151	12	164	2,063
2039	894	1,332	2,226	137	6	143	2,083
2040	893	1,333	2,226	122	0	122	2,104
2041	892	1,333	2,225	126	0	126	2,099
2042	891	1,333	2,224	130	0	130	2,094
2043	890	1,333	2,224	134	0	134	2,090
2044	889	1,334	2,223	138	0	138	2,085
2045	888	1,334	2,222	142	0	142	2,080
2046	887	1,334	2,221	146	0	146	2,075
2047	886	1,334	2,220	150	0	150	2,070
2048	885	1,334	2,219	153	0	153	2,066
2049	884	1,334	2,218	157	0	157	2,061
2050	883	1,334	2,217	161	0	161	2,056
2051	883	1,334	2,217	165	0	165	2,052
2052	883	1,334	2,217	169	0	169	2,048
2053	883	1,334	2,217	173	0	173	2,044
2054	883	1,334	2,217	177	0	177	2,040
2055	883	1,334	2,217	181	0	181	2,036
2056	882	1,334	2,217	185	0	185	2,032
2057	882	1,334	2,217	189	0	189	2,028
2058	882	1,334	2,217	193	0	193	2,024
2059	882	1,335	2,217	197	0	197	2,019
2060	882	1,335	2,216	201	0	201	2,015
2061	882	1,335	2,217	205	0	205	2,011
2062	882	1,335	2,217	209	0	209	2,008
2063	882	1,335	2,217	213	0	213	2,004
2064	882	1,335	2,217	217	0	217	2,000
2065	882	1,335	2,217	221	0	221	1,996
2066	882	1,335	2,217	225	0	225	1,992
2067	882	1,335	2,217	229	0	229	1,988
2068	882	1,335	2,218	233	0	233	1,984
2069	882	1,335	2,218	237	0	237	1,980
2070	882	1,335	2,218	241	0	241	1,976

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Garland's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	145	0	0	0
1	2015	236,897	144	69	2,093	2,024
2	2016	236,448	143	138	2,195	2,057
3	2017	235,998	143	207	2,193	1,986
4	2018	235,549	142	275	2,191	1,915
5-year Goal	2019	235,099	141	343	2,188	1,845
6	2020	234,650	140	394	2,186	1,792
7	2021	235,362	140	447	2,190	1,744
8	2022	236,073	139	500	2,195	1,695
9	2023	236,785	139	553	2,199	1,646
10-year Goal	2024	237,497	138	607	2,203	1,596

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Garland's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	236,897	20.00	0	1,297	1,297
2	2016	236,448	20.00	0	1,295	1,295
3	2017	235,998	20.00	0	1,292	1,292
4	2018	235,549	20.00	0	1,290	1,290
5-year Goal	2019	235,099	20.00	0	1,287	1,287
6	2020	234,650	19.80	17	1,285	1,268
7	2021	235,362	19.60	34	1,289	1,254
8	2022	236,073	19.40	52	1,293	1,241
9	2023	236,785	19.20	69	1,296	1,227
10-year Goal	2024	237,497	19.00	87	1,300	1,214

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 1,297 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 14.6% increase in 2015
        ii. 3.8% increase in 2016
    b. Estimated customer demand reduction of 3.7%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
   a. Estimated savings of 3.48% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
   b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **WaterWise Take-home Kits**
   a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
   b. Conservative 5-year useful life for all items in kit
   c. 15% adoption rate assumed

8. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
   a. Project initiated in service area in 2014
   b. Save Water completed work on 528 multi-family units in 2016
   c. Average monthly savings of 1,321,257 gallons
   d. Annualized savings of 15.85 MG for the life of the retrofitted fixtures
   e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
   f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
   g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance (peak-season)	Take-home Kits	Water Rate Increases	Save Water Co. Program	TOTAL SAVINGS
2009		0.5			0.5
2010		0.5			0.5
2011		0.5			0.5
2012		0.5			0.5
2013	428	0.5			428
2014	428	0.5		8.2	437
2015	428	0.5	357	10.0	796
2016	428	0.5	456	15.8	901
2017	428	0.3	456	15.8	901
2018	429	0.2	456	15.8	901
2019	429	0.1	456	15.8	901
2020	429	0.03	457	15.8	901
2021	429		457	15.8	902
2022	429		457	15.8	902
2023	429		457	15.8	902
2024	430		457	15.8	903
2025	430		457	15.8	903
2026	430		458	15.8	903
2027	430		458	15.8	904
2028	430		458	15.8	904
2029	430		458	15.8	904
2030	430		458	15.8	905
2031	430		458	15.8	903
2032	429		457	15.8	902
2033	429		456	15.8	901
2034	428		456	15.8	900
2035	428		455	15.8	899
2036	427		455	15.8	898
2037	426		454	15.8	896
2038	426		453	15.8	895
2039	425		453	15.8	894
2040	425		452	15.8	893
2041	424		452	15.8	892
2042	424		451	15.8	891
2043	423		451	15.8	890
2044	423		450	15.8	889
2045	422		450	15.8	888
2046	422		449	15.8	887
2047	422		449	15.8	886
2048	421		448	15.8	885
2049	421		448	15.8	884
2050	420		447	15.8	883
2051	420		447	15.8	883
2052	420		447	15.8	883
2053	420		447	15.8	883
2054	420		447	15.8	883
2055	420		447	15.8	883
2056	420		447	15.8	882
2057	420		447	15.8	882
2058	420		447	15.8	882
2059	420		447	15.8	882
2060	419		447	15.8	882
2061	419		447	15.8	882
2062	419		447	15.8	882
2063	420		447	15.8	882
2064	420		447	15.8	882
2065	420		447	15.8	882
2066	420		447	15.8	882
2067	420		447	15.8	882
2068	420		447	15.8	882
2069	420		447	15.8	882
2070	420		447	15.8	882

Table 5-2. **Savings from Water Loss Reduction (MG).**

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	236,897	5.00	1,297
2016	236,448	5.00	1,295
2017	235,998	5.00	1,292
2018	235,549	5.00	1,290
2019	235,099	5.00	1,287
2020	234,650	5.00	1,285
2021	235,362	5.00	1,289
2022	236,073	5.00	1,293
2023	236,785	5.00	1,296
2024	237,497	5.00	1,300

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year #	Year	Utility Population	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
5	2016	236,448	901	1,295	2,195	165	91	34	125	2,235
6	2017	235,998	901	1,292	2,193	165	91	41	132	2,226
7	2018	235,549	901	1,290	2,191	165	109	48	157	2,199
8	2019	235,099	901	1,287	2,188	165	128	55	182	2,171
9	2020	234,650	901	1,285	2,186	165	164	62	226	2,126
10	2021	235,362	902	1,289	2,190	165	174	62	236	2,120
11	2022	236,073	902	1,293	2,195	166	185	62	246	2,114
12	2023	236,785	902	1,296	2,199	166	195	62	257	2,107
13	2024	237,497	903	1,300	2,203	166	206	62	267	2,101
14	2025	238,209	903	1,304	2,207	166	216	62	278	2,095
15	2026	238,920	903	1,308	2,211	166	227	62	288	2,089
16	2027	239,632	904	1,312	2,216	166	237	62	299	2,083
17	2028	240,344	904	1,316	2,220	166	247	62	309	2,077
18	2029	241,055	904	1,320	2,224	166	258	62	319	2,071
19	2030	241,767	905	1,324	2,228	166	268	62	330	2,064
20	2031	241,943	903	1,325	2,228	166	254	55	309	2,085
21	2032	242,118	902	1,326	2,228	166	239	49	288	2,105
22	2033	242,294	901	1,327	2,228	165	224	43	268	2,125
23	2034	242,469	900	1,328	2,227	165	210	37	247	2,146
24	2035	242,645	899	1,328	2,227	165	195	31	226	2,166
25	2036	242,820	898	1,329	2,227	165	181	25	205	2,186
26	2037	242,996	896	1,330	2,227	164	166	18	184	2,207
27	2038	243,171	895	1,331	2,227	164	151	12	164	2,227
28	2039	243,347	894	1,332	2,226	164	137	6	143	2,247
29	2040	243,522	893	1,333	2,226	164	122	0	122	2,268

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Grand Prairie Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Grand Prairie's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Grand Prairie's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Grand Prairie's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Grand Prairie with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	844	(343)	502	68	25	93	408
2016	956	(354)	602	85	32	117	485
2017	1,070	(365)	705	85	38	123	582
2018	1,088	(376)	712	102	45	147	566
2019	1,106	(387)	719	119	51	170	549
2020	1,124	(398)	726	153	57	210	516
2021	1,142	(406)	736	166	57	224	513
2022	1,160	(413)	747	180	57	237	510
2023	1,178	(420)	758	193	57	251	507
2024	1,196	(428)	768	207	57	264	504
2025	1,214	(435)	779	220	57	278	501
2026	1,232	(443)	789	234	57	291	498
2027	1,250	(450)	800	248	57	305	495
2028	1,268	(457)	810	261	57	318	492
2029	1,286	(465)	821	275	57	332	489
2030	1,304	(472)	831	288	57	345	486
2031	1,314	(477)	838	274	52	325	512
2032	1,325	(481)	844	259	46	305	539
2033	1,336	(486)	850	245	40	285	565
2034	1,346	(490)	856	230	34	265	591
2035	1,357	(495)	862	216	29	245	617
2036	1,368	(499)	868	202	23	225	644
2037	1,378	(504)	875	187	17	204	670
2038	1,389	(508)	881	173	11	184	696
2039	1,400	(513)	887	158	6	164	723
2040	1,411	(517)	893	144	0	144	749
2041	1,410	(517)	892	149	0	149	744
2042	1,409	(517)	892	153	0	153	738
2043	1,408	(517)	891	158	0	158	733
2044	1,407	(517)	890	163	0	163	727
2045	1,406	(517)	889	167	0	167	722
2046	1,406	(517)	888	172	0	172	716
2047	1,405	(517)	887	177	0	177	711
2048	1,404	(517)	887	181	0	181	705
2049	1,403	(517)	886	186	0	186	700
2050	1,402	(517)	885	191	0	191	694
2051	1,402	(517)	885	195	0	195	689
2052	1,402	(517)	885	200	0	200	684
2053	1,402	(517)	884	205	0	205	679
2054	1,402	(517)	884	210	0	210	675
2055	1,401	(517)	884	214	0	214	670
2056	1,401	(517)	884	219	0	219	665
2057	1,401	(517)	884	224	0	224	660
2058	1,401	(517)	883	229	0	229	655
2059	1,401	(517)	883	233	0	233	650
2060	1,400	(517)	883	238	0	238	645
2061	1,400	(517)	883	243	0	243	640
2062	1,400	(517)	883	248	0	248	635
2063	1,400	(517)	883	253	0	253	630
2064	1,400	(517)	883	257	0	257	626
2065	1,400	(517)	883	262	0	262	621
2066	1,400	(517)	883	267	0	267	616
2067	1,400	(518)	883	272	0	272	611
2068	1,400	(518)	883	276	0	276	607
2069	1,400	(518)	883	281	0	281	602
2070	1,400	(518)	883	286	0	286	597

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Grand Prairie's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years..

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	141	0	0	0
1	2015	187,809	138	178	502	323
2	2016	193,880	136	368	602	234
3	2017	199,950	133	569	705	136
4	2018	206,021	131	782	712	(70)
5-year Goal	2019	212,091	128	1,006	719	(287)
6	2020	218,162	128	1,035	726	(309)
7	2021	222,222	128	1,054	736	(318)
8	2022	226,281	128	1,074	747	(327)
9	2023	230,341	128	1,093	758	(335)
10-year Goal	2024	234,401	128	1,112	768	(344)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Grand Prairie's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2015	187,809	10.00	(69)	(343)	(274)
2	2016	193,880	11.00	(142)	(354)	(212)
3	2017	199,950	12.00	(219)	(365)	(146)
4	2018	206,021	13.00	(301)	(376)	(75)
5-year Goal	2019	212,091	14.00	(387)	(387)	0
6	2020	218,162	13.20	(334)	(398)	(64)
7	2021	222,222	12.40	(276)	(406)	(130)
8	2022	226,281	11.60	(215)	(413)	(198)
9	2023	230,341	10.80	(151)	(420)	(269)
10-year Goal	2024	234,401	10.00	(86)	(428)	(342)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service
    c. "WaterSmart" resources page

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 343 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 4.48% increase in 2016
        ii. 4.51% increase in 2017
    b. Estimated customer demand reduction of 1.8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2012	800		800
2013	815		815
2014	830		830
2015	844		844
2016	859	97	956
2017	874	197	1,070
2018	888	200	1,088
2019	903	203	1,106
2020	918	206	1,124
2021	932	210	1,142
2022	947	213	1,160
2023	962	216	1,178
2024	976	220	1,196
2025	991	223	1,214
2026	1,006	226	1,232
2027	1,020	230	1,250
2028	1,035	233	1,268
2029	1,049	236	1,286
2030	1,064	239	1,304
2031	1,073	241	1,314
2032	1,082	243	1,325
2033	1,090	245	1,336
2034	1,099	247	1,346
2035	1,108	249	1,357
2036	1,117	251	1,368
2037	1,125	253	1,378
2038	1,134	255	1,389
2039	1,143	257	1,400
2040	1,151	259	1,411
2041	1,151	259	1,410
2042	1,150	259	1,409
2043	1,149	259	1,408
2044	1,149	258	1,407
2045	1,148	258	1,406
2046	1,147	258	1,406
2047	1,147	258	1,405
2048	1,146	258	1,404
2049	1,145	258	1,403
2050	1,145	258	1,402
2051	1,145	258	1,402
2052	1,145	258	1,402
2053	1,144	257	1,402
2054	1,144	257	1,402
2055	1,144	257	1,401
2056	1,144	257	1,401
2057	1,144	257	1,401
2058	1,144	257	1,401
2059	1,143	257	1,401
2060	1,143	257	1,400
2061	1,143	257	1,400
2062	1,143	257	1,400
2063	1,143	257	1,400
2064	1,143	257	1,400
2065	1,143	257	1,400
2066	1,143	257	1,400
2067	1,143	257	1,400
2068	1,143	257	1,400
2069	1,143	257	1,400
2070	1,143	257	1,400

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	187,809	14.00	(343)
2016	193,880	14.00	(354)
2017	199,950	14.00	(365)
2018	206,021	14.00	(376)
2019	212,091	14.00	(387)
2020	218,162	14.00	(398)
2021	222,222	14.00	(406)
2022	226,281	14.00	(413)
2023	230,341	14.00	(420)
2024	234,401	14.00	(428)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	956	(354)	602	144	85	32	117	629
2017	1,070	(365)	705	146	85	38	123	728
2018	1,088	(376)	712	149	102	45	147	714
2019	1,106	(387)	719	151	119	51	170	700
2020	1,124	(398)	726	154	153	57	210	669
2021	1,142	(406)	736	156	166	57	224	669
2022	1,160	(413)	747	159	180	57	237	668
2023	1,178	(420)	758	161	193	57	251	668
2024	1,196	(428)	768	164	207	57	264	667
2025	1,214	(435)	779	166	220	57	278	667
2026	1,232	(443)	789	168	234	57	291	666
2027	1,250	(450)	800	171	248	57	305	666
2028	1,268	(457)	810	173	261	57	318	665
2029	1,286	(465)	821	176	275	57	332	665
2030	1,304	(472)	831	178	288	57	345	664
2031	1,314	(477)	838	180	274	52	325	692
2032	1,325	(481)	844	181	259	46	305	720
2033	1,336	(486)	850	183	245	40	285	747
2034	1,346	(490)	856	184	230	34	265	775
2035	1,357	(495)	862	186	216	29	245	803
2036	1,368	(499)	868	187	202	23	225	831
2037	1,378	(504)	875	188	187	17	204	859
2038	1,389	(508)	881	190	173	11	184	886
2039	1,400	(513)	887	191	158	6	164	914
2040	1,411	(517)	893	193	144	0	144	942

2. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Grapevine Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Grapevine's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Grapevine's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Grapevine's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Grapevine with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	522	3.75	525	36	13	49	476
2016	70	3.77	74	45	17	61	13
2017	141	3.78	145	45	20	65	80
2018	142	3.80	146	54	23	77	69
2019	144	3.81	148	63	27	89	59
2020	146	3.83	149	80	30	110	39
2021	147	3.87	151	87	30	117	34
2022	149	3.92	152	93	30	123	29
2023	150	3.97	154	100	30	130	24
2024	152	4.02	156	106	30	136	19
2025	153	4.06	157	113	30	143	14
2026	155	4.11	159	119	30	149	10
2027	156	4.16	160	126	30	156	5
2028	158	4.21	162	132	30	162	(0)
2029	159	4.25	164	139	30	169	(5)
2030	161	4.30	165	145	30	175	(10)
2031	161	4.31	165	151	27	178	(12)
2032	161	4.32	165	157	24	181	(15)
2033	161	4.33	166	162	21	183	(18)
2034	161	4.33	166	168	18	186	(20)
2035	162	4.34	166	174	15	189	(23)
2036	162	4.35	166	180	12	192	(25)
2037	162	4.36	166	185	9	194	(28)
2038	162	4.36	166	191	6	197	(31)
2039	162	4.37	167	197	3	200	(33)
2040	162	4.38	167	203	0	203	(36)
2041	162	4.38	167	205	0	205	(38)
2042	162	4.38	167	207	0	207	(40)
2043	162	4.38	167	209	0	209	(43)
2044	162	4.38	167	211	0	211	(45)
2045	162	4.38	166	213	0	213	(47)
2046	162	4.38	166	216	0	216	(49)
2047	162	4.38	166	218	0	218	(51)
2048	162	4.38	166	220	0	220	(54)
2049	162	4.38	166	222	0	222	(56)
2050	162	4.38	166	224	0	224	(58)
2051	162	4.38	166	226	0	226	(60)
2052	162	4.38	166	229	0	229	(62)
2053	162	4.38	166	231	0	231	(65)
2054	162	4.38	166	233	0	233	(67)
2055	162	4.38	166	235	0	235	(69)
2056	162	4.38	166	238	0	238	(71)
2057	162	4.38	166	240	0	240	(74)
2058	162	4.38	166	242	0	242	(76)
2059	162	4.38	166	244	0	244	(78)
2060	162	4.38	166	246	0	246	(80)
2061	162	4.38	166	249	0	249	(83)
2062	162	4.38	166	251	0	251	(85)
2063	162	4.38	166	253	0	253	(87)
2064	162	4.38	166	255	0	255	(89)
2065	162	4.38	166	257	0	257	(91)
2066	162	4.38	166	260	0	260	(94)
2067	162	4.38	166	262	0	262	(96)
2068	162	4.38	166	264	0	264	(98)
2069	162	4.38	166	266	0	266	(100)
2070	162	4.38	166	269	0	269	(102)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Grapevine's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	234	0	0	0
1	2015	51,404	229	94	525	432
2	2016	51,606	224	188	74	(114)
3	2017	51,808	219	284	145	(139)
4	2018	52,010	214	380	146	(233)
5-year Goal	2019	52,212	209	476	148	(329)
6	2020	52,414	209	482	149	(333)
7	2021	53,066	209	492	151	(341)
8	2022	53,717	208	502	152	(349)
9	2023	54,369	208	512	154	(358)
10-year Goal	2024	55,020	208	522	156	(367)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Grapevine's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	5.60	0	0	0
1	2015	51,404	5.88	(5)	3.75	9
2	2016	51,606	6.16	(11)	3.77	14
3	2017	51,808	6.44	(16)	3.78	20
4	2018	52,010	6.72	(21)	3.80	25
5-year Goal	2019	52,212	7.00	(27)	3.81	30
6	2020	52,414	7.00	(27)	3.83	31
7	2021	53,066	7.00	(27)	3.87	31
8	2022	53,717	7.00	(27)	3.92	31
9	2023	54,369	7.00	(28)	3.97	32
10-year Goal	2024	55,020	7.00	(28)	4.02	32

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 3.75 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.5% increase in 2016
        ii. 6.0% increase in 2017
    b. Estimated customer demand reduction of 2.3%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

6. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

a. Project initiated in service area in 2015
b. Save Water completed work on 218 multi-family units in 2015
c. Average monthly savings of 590,383 gallons
d. Annualized savings of 7 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Save Water Co. Program	Water Rate Increases	TOTAL SAVINGS
2009				0
2010				0
2011				0
2012				0
2013	503			502.5
2014	509			508.5
2015	515	7		521.6
2016		7	63	70.4
2017		7	134	140.9
2018		7	135	142.4
2019		7	137	144.0
2020		7	138	145.5
2021		7	140	147.0
2022		7	141	148.6
2023		7	143	150.1
2024		7	145	151.6
2025		7	146	153.2
2026		7	148	154.7
2027		7	149	156.2
2028		7	151	157.7
2029		7	152	159.3
2030		7	154	160.8
2031		7	154	161.0
2032		7	154	161.1
2033		7	154	161.3
2034		7	154	161.5
2035		7	155	161.6
2036		7	155	161.8
2037		7	155	161.9
2038		7	155	162.1
2039		7	155	162.3
2040		7	155	162.4
2041		7	155	162.4
2042		7	155	162.3
2043		7	155	162.2
2044		7	155	162.2
2045		7	155	162.1
2046		7	155	162.1
2047		7	155	162.0
2048		7	155	161.9
2049		7	155	161.9
2050		7	155	161.8
2051		7	155	161.8
2052		7	155	161.8
2053		7	155	161.8
2054		7	155	161.7
2055		7	155	161.7
2056		7	155	161.7
2057		7	155	161.7
2058		7	155	161.7
2059		7	155	161.7
2060		7	155	161.7
2061		7	155	161.7
2062		7	155	161.7
2063		7	155	161.7
2064		7	155	161.7
2065		7	155	161.7
2066		7	155	161.7
2067		7	155	161.7
2068		7	155	161.7
2069		7	155	161.7
2070		7	155	161.7

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	5.60	0
2015	51,404	5.40	4
2016	51,606	5.40	4
2017	51,808	5.40	4
2018	52,010	5.40	4
2019	52,212	5.40	4
2020	52,414	5.40	4
2021	53,066	5.40	4
2022	53,717	5.40	4
2023	54,369	5.40	4
2024	55,020	5.40	4

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. This suggested activity is included to show potential savings if the measure is made permanent.

i. Staff indicated that such a restriction was in place from 2013 – 2015.

b. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region C savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

c. Savings could be 460 MG per year with current demand.

d. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	70	4	74	460	45	17	61	473
2017	141	4	145	465	45	20	65	545
2018	142	4	146	471	54	23	77	540
2019	144	4	148	476	63	27	89	535
2020	146	4	149	481	80	30	110	520
2021	147	4	151	487	87	30	117	521
2022	149	4	152	492	93	30	123	521
2023	150	4	154	497	100	30	130	522
2024	152	4	156	503	106	30	136	522
2025	153	4	157	508	113	30	143	523
2026	155	4	159	513	119	30	149	523
2027	156	4	160	519	126	30	156	523
2028	158	4	162	524	132	30	162	524
2029	159	4	164	529	139	30	169	524
2030	161	4	165	535	145	30	175	525
2031	161	4	165	535	151	27	178	523
2032	161	4	165	536	157	24	181	521
2033	161	4	166	536	162	21	183	519
2034	161	4	166	537	168	18	186	517
2035	162	4	166	538	174	15	189	515
2036	162	4	166	538	180	12	192	513
2037	162	4	166	539	185	9	194	511
2038	162	4	166	539	191	6	197	509
2039	162	4	167	540	197	3	200	506
2040	162	4	167	540	203	0	203	504

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	70	4	74	77	45	17	61	90
2017	141	4	145	78	45	20	65	158
2018	142	4	146	79	54	23	77	148
2019	144	4	148	80	63	27	89	138
2020	146	4	149	81	80	30	110	119
2021	147	4	151	82	87	30	117	116
2022	149	4	152	82	93	30	123	112
2023	150	4	154	83	100	30	130	108
2024	152	4	156	84	106	30	136	104
2025	153	4	157	85	113	30	143	100
2026	155	4	159	86	119	30	149	96
2027	156	4	160	87	126	30	156	92
2028	158	4	162	88	132	30	162	88
2029	159	4	164	89	139	30	169	84
2030	161	4	165	90	145	30	175	80
2031	161	4	165	90	151	27	178	77
2032	161	4	165	90	157	24	181	75
2033	161	4	166	90	162	21	183	72
2034	161	4	166	90	168	18	186	70
2035	162	4	166	90	174	15	189	67
2036	162	4	166	90	180	12	192	65
2037	162	4	166	90	185	9	194	62
2038	162	4	166	90	191	6	197	60
2039	162	4	167	90	197	3	200	57
2040	162	4	167	91	203	0	203	55

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Haltom City Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Haltom City's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Haltom City's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Haltom City's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Haltom City with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	171	(24)	147	3	4	6	141
2016	197	(24)	173	3	5	8	165
2017	197	(24)	173	3	6	9	164
2018	197	(25)	172	4	7	11	162
2019	197	(25)	172	5	8	12	160
2020	196	(25)	172	6	8	14	157
2021	196	(25)	171	6	8	15	156
2022	196	(25)	171	7	8	15	156
2023	196	(25)	171	8	8	16	155
2024	195	(25)	171	8	8	17	154
2025	195	(25)	170	9	8	17	153
2026	195	(25)	170	9	8	18	152
2027	195	(25)	170	10	8	18	151
2028	195	(25)	169	10	8	19	151
2029	194	(25)	169	11	8	19	150
2030	194	(25)	169	11	8	20	149
2031	194	(25)	169	12	8	20	149
2032	195	(26)	169	13	7	19	150
2033	195	(26)	169	13	6	19	150
2034	195	(26)	170	14	5	19	151
2035	196	(26)	170	14	4	19	151
2036	196	(26)	170	15	3	18	152
2037	196	(26)	170	16	3	18	152
2038	197	(26)	170	16	2	18	153
2039	197	(26)	171	17	1	18	153
2040	197	(26)	171	17	0	17	154
2041	199	(27)	172	18	0	18	154
2042	200	(27)	173	19	0	19	154
2043	201	(27)	174	20	0	20	155
2044	203	(27)	175	20	0	20	155
2045	204	(28)	176	21	0	21	155
2046	205	(28)	178	22	0	22	156
2047	207	(28)	179	23	0	23	156
2048	208	(28)	180	23	0	23	156
2049	209	(28)	181	24	0	24	157
2050	211	(29)	182	25	0	25	157
2051	212	(29)	183	26	0	26	158
2052	214	(29)	185	26	0	26	158
2053	215	(29)	186	27	0	27	159
2054	217	(30)	187	28	0	28	159
2055	219	(30)	189	29	0	29	160
2056	220	(30)	190	30	0	30	160
2057	222	(30)	191	31	0	31	161
2058	223	(30)	193	32	0	32	161
2059	225	(31)	194	32	0	32	162
2060	226	(31)	195	33	0	33	162
2061	228	(31)	197	34	0	34	163
2062	230	(31)	199	35	0	35	164
2063	232	(32)	201	36	0	36	164
2064	234	(32)	202	37	0	37	165
2065	237	(32)	204	38	0	38	166
2066	239	(33)	206	39	0	39	167
2067	241	(33)	208	40	0	40	167
2068	243	(33)	209	41	0	41	168
2069	245	(33)	211	42	0	42	169
2070	247	(34)	213	43	0	43	170

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Haltom City's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	118	0	0	0
1	2015	43,206	116	38	147	109
2	2016	43,365	113	76	173	97
3	2017	43,524	111	114	173	58
4	2018	43,682	108	153	172	19
5-year Goal	2019	43,841	106	192	172	(20)
6	2020	44,000	105	212	172	(40)
7	2021	44,100	104	232	171	(60)
8	2022	44,200	102	252	171	(81)
9	2023	44,300	101	272	171	(101)
10-year Goal	2024	44,400	100	292	171	(121)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Haltom City's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.46	0	0	0
1	2015	43,206	14.06	6	(24)	(31)
2	2016	43,365	13.66	13	(24)	(37)
3	2017	43,524	13.26	19	(24)	(44)
4	2018	43,682	12.86	26	(25)	(50)
5-year Goal	2019	43,841	12.46	32	(25)	(57)
6	2020	44,000	12.26	35	(25)	(60)
7	2021	44,100	12.06	39	(25)	(63)
8	2022	44,200	11.86	42	(25)	(67)
9	2023	44,300	11.66	45	(25)	(70)
10-year Goal	2024	44,400	11.46	49	(25)	(74)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 24 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 9.5% increase in 2015
        ii. 8.5% increase in 2016
    b. Estimated customer demand reduction of 3.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014	139		139
2015	139	33	171
2016	138	59	197
2017	138	59	197
2018	138	59	197
2019	138	59	197
2020	138	59	196
2021	138	58	196
2022	137	58	196
2023	137	58	196
2024	137	58	195
2025	137	58	195
2026	137	58	195
2027	137	58	195
2028	137	58	195
2029	136	58	194
2030	136	58	194
2031	136	58	194
2032	137	58	195
2033	137	58	195
2034	137	58	195
2035	137	58	196
2036	138	58	196
2037	138	59	196
2038	138	59	197
2039	138	59	197
2040	138	59	197
2041	139	59	199
2042	140	60	200
2043	141	60	201
2044	142	60	203
2045	143	61	204
2046	144	61	205
2047	145	62	207
2048	146	62	208
2049	147	62	209
2050	148	63	211
2051	149	63	212
2052	150	64	214
2053	151	64	215
2054	152	65	217
2055	153	65	219
2056	154	66	220
2057	156	66	222
2058	157	67	223
2059	158	67	225
2060	159	68	226
2061	160	68	228
2062	162	69	230
2063	163	69	232
2064	165	70	234
2065	166	71	237
2066	167	71	239
2067	169	72	241
2068	170	72	243
2069	172	73	245
2070	173	74	247

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.46	0
2015	43,206	16.00	(24)
2016	43,365	16.00	(24)
2017	43,524	16.00	(24)
2018	43,682	16.00	(25)
2019	43,841	16.00	(25)
2020	44,000	16.00	(25)
2021	44,100	16.00	(25)
2022	44,200	16.00	(25)
2023	44,300	16.00	(25)
2024	44,400	16.00	(25)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	197	(24)	173	23	3	5	8	188
2017	197	(24)	173	23	3	6	9	187
2018	197	(25)	172	23	4	7	11	185
2019	197	(25)	172	23	5	8	12	183
2020	196	(25)	172	23	6	8	14	180
2021	196	(25)	171	23	6	8	15	180
2022	196	(25)	171	23	7	8	15	179
2023	196	(25)	171	23	8	8	16	178
2024	195	(25)	171	23	8	8	17	177
2025	195	(25)	170	23	9	8	17	176
2026	195	(25)	170	23	9	8	18	175
2027	195	(25)	170	23	10	8	18	174
2028	195	(25)	169	23	10	8	19	174
2029	194	(25)	169	23	11	8	19	173
2030	194	(25)	169	23	11	8	20	172
2031	194	(25)	169	23	12	8	20	172
2032	195	(26)	169	23	13	7	19	173
2033	195	(26)	169	23	13	6	19	173
2034	195	(26)	170	23	14	5	19	174
2035	196	(26)	170	23	14	4	19	174
2036	196	(26)	170	23	15	3	18	175
2037	196	(26)	170	23	16	3	18	175
2038	197	(26)	170	23	16	2	18	176
2039	197	(26)	171	23	17	1	18	176
2040	197	(26)	171	23	17	0	17	177

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Highland Park Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Highland Park's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Highland Park's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Highland Park's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Highland Park with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	153	54	207	2	3	5	202
2016	153	53	207	3	4	6	201
2017	154	53	207	3	4	7	200
2018	154	53	207	3	5	8	199
2019	154	53	207	4	6	9	198
2020	154	53	207	5	7	11	196
2021	155	53	207	5	7	12	196
2022	155	53	208	5	7	12	196
2023	155	53	208	6	7	12	196
2024	156	53	209	6	7	13	196
2025	156	54	209	7	7	13	196
2026	156	54	210	7	7	14	196
2027	157	54	210	8	7	14	196
2028	157	54	211	8	7	15	196
2029	157	54	211	9	7	15	196
2030	157	54	212	9	7	16	196
2031	157	54	212	10	6	15	196
2032	157	54	212	10	5	15	196
2033	157	54	211	10	5	15	197
2034	157	54	211	11	4	15	197
2035	157	54	211	11	3	15	197
2036	157	54	211	12	3	14	197
2037	157	54	211	12	2	14	197
2038	156	54	211	13	1	14	197
2039	156	54	211	13	1	14	197
2040	156	54	211	13	0	13	197
2041	156	54	210	14	0	14	197
2042	156	54	210	14	0	14	196
2043	156	54	210	15	0	15	196
2044	156	54	210	15	0	15	195
2045	156	54	210	16	0	16	195
2046	156	54	210	16	0	16	194
2047	156	54	210	17	0	17	194
2048	156	54	210	17	0	17	193
2049	156	54	210	17	0	17	193
2050	156	54	210	18	0	18	192
2051	156	54	210	18	0	18	192
2052	156	54	210	19	0	19	191
2053	156	54	210	19	0	19	191
2054	156	54	210	20	0	20	190
2055	156	54	210	20	0	20	190
2056	156	54	210	20	0	20	189
2057	156	54	210	21	0	21	189
2058	155	54	210	21	0	21	189
2059	155	54	210	22	0	22	188
2060	155	54	210	22	0	22	188
2061	155	54	210	23	0	23	187
2062	155	54	210	23	0	23	187
2063	155	54	210	24	0	24	186
2064	155	54	210	24	0	24	186
2065	155	54	210	24	0	24	185
2066	155	54	210	25	0	25	185
2067	155	54	210	25	0	25	185
2068	155	54	210	26	0	26	184
2069	155	54	210	26	0	26	184
2070	155	54	210	27	0	27	183

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Highland Park's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	407	0	0	0
1	2015	9,189	397	33	207	174
2	2016	9,156	387	66	207	141
3	2017	9,123	378	98	207	109
4	2018	9,091	368	130	207	77
5-year Goal	2019	9,058	358	162	207	45
6	2020	9,025	358	163	207	44
7	2021	9,054	357	165	207	43
8	2022	9,083	357	166	208	42
9	2023	9,111	356	168	208	40
10-year Goal	2024	9,140	356	170	209	39

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Highland Park's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	36.00	0	0	0
1	2015	9,189	35.96	0	54	54
2	2016	9,156	35.92	0	53	53
3	2017	9,123	35.88	0	53	53
4	2018	9,091	35.84	1	53	53
5-year Goal	2019	9,058	35.80	1	53	52
6	2020	9,025	35.76	1	53	52
7	2021	9,054	35.72	1	53	52
8	2022	9,083	35.68	1	53	52
9	2023	9,111	35.64	1	53	52
10-year Goal	2024	9,140	35.60	1	53	52

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 54 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 8.68% increase and 12.5% increase in 2015
    b. Estimated customer demand reduction of 2.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 9.47% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Outdoor landscape evaluations for single family (SF) customers**
    a. 80 outdoor evaluations performed since 2015
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical, 2005; Whitcomb, 2000)
        i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
        i. 20% decay rate per year attributed to customer behavior (A&N Technical, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Residential Surveys (SF)	Water Rate Increases	TOTAL SAVINGS
2012				0
2013				0
2014	124			124
2015	124	0.6	28.8	153
2016	124	0.5	28.8	153
2017	124	0.4	28.9	154
2018	125	0.3	29.0	154
2019	125	0.1	29.0	154
2020	125		29.1	154
2021	125		29.1	155
2022	126		29.2	155
2023	126		29.3	155
2024	126		29.3	156
2025	126		29.4	156
2026	127		29.4	156
2027	127		29.5	157
2028	127		29.6	157
2029	128		29.6	157
2030	128		29.7	157
2031	128		29.7	157
2032	128		29.6	157
2033	127		29.6	157
2034	127		29.6	157
2035	127		29.6	157
2036	127		29.5	157
2037	127		29.5	157
2038	127		29.5	156
2039	127		29.5	156
2040	127		29.4	156
2041	127		29.4	156
2042	127		29.4	156
2043	127		29.4	156
2044	127		29.4	156
2045	126		29.4	156
2046	126		29.4	156
2047	126		29.4	156
2048	126		29.4	156
2049	126		29.3	156
2050	126		29.3	156
2051	126		29.3	156
2052	126		29.3	156
2053	126		29.3	156
2054	126		29.3	156
2055	126		29.3	156
2056	126		29.3	156
2057	126		29.3	156
2058	126		29.3	155
2059	126		29.3	155
2060	126		29.3	155
2061	126		29.3	155
2062	126		29.3	155
2063	126		29.3	155
2064	126		29.3	155
2065	126		29.3	155
2066	126		29.3	155
2067	126		29.3	155
2068	126		29.3	155
2069	126		29.3	155
2070	126		29.3	155

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	36.00	0
2015	9,189	20.00	54
2016	9,156	20.00	53
2017	9,123	20.00	53
2018	9,091	20.00	53
2019	9,058	20.00	53
2020	9,025	20.00	53
2021	9,054	20.00	53
2022	9,083	20.00	53
2023	9,111	20.00	53
2024	9,140	20.00	53

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	153	53	207	18	3	4	6	218
2017	154	53	207	18	3	4	7	218
2018	154	53	207	18	3	5	8	216
2019	154	53	207	18	4	6	9	215
2020	154	53	207	18	5	7	11	214
2021	155	53	207	18	5	7	12	214
2022	155	53	208	18	5	7	12	214
2023	155	53	208	18	6	7	12	214
2024	156	53	209	18	6	7	13	214
2025	156	54	209	18	7	7	13	214
2026	156	54	210	18	7	7	14	214
2027	157	54	210	18	8	7	14	214
2028	157	54	211	18	8	7	15	214
2029	157	54	211	18	9	7	15	214
2030	157	54	212	18	9	7	16	214
2031	157	54	212	18	10	6	15	214
2032	157	54	212	18	10	5	15	214
2033	157	54	211	18	10	5	15	215
2034	157	54	211	18	11	4	15	215
2035	157	54	211	18	11	3	15	215
2036	157	54	211	18	12	3	14	215
2037	157	54	211	18	12	2	14	215
2038	156	54	211	18	13	1	14	215
2039	156	54	211	18	13	1	14	215
2040	156	54	211	18	13	0	13	215

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Highland Village Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Highland Village's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Highland Village's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Highland Village's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Highland Village with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	72	30	102	7	3	10	92
2016	72	30	102	9	3	13	90
2017	72	31	103	9	4	13	89
2018	72	31	103	11	5	16	87
2019	72	31	103	13	6	18	85
2020	73	31	104	17	6	23	81
2021	73	31	104	18	6	24	80
2022	73	32	104	19	6	25	79
2023	73	32	105	20	6	26	79
2024	73	32	105	21	6	27	78
2025	73	32	105	22	6	29	77
2026	74	32	106	23	6	30	76
2027	74	32	106	25	6	31	75
2028	74	33	106	26	6	32	74
2029	74	33	107	27	6	33	74
2030	74	33	107	28	6	34	73
2031	74	33	107	29	6	35	72
2032	74	33	107	30	5	35	72
2033	74	33	107	31	4	35	71
2034	74	33	107	32	4	36	71
2035	74	33	107	33	3	36	70
2036	74	33	107	34	2	37	70
2037	74	33	107	35	2	37	70
2038	74	33	106	36	1	37	69
2039	74	33	106	37	1	38	69
2040	73	33	106	38	0	38	68
2041	73	33	106	39	0	39	68
2042	73	33	106	39	0	39	67
2043	73	33	106	39	0	39	67
2044	73	33	106	40	0	40	66
2045	73	33	106	40	0	40	66
2046	73	33	106	41	0	41	66
2047	73	33	106	41	0	41	65
2048	73	33	106	42	0	42	65
2049	73	33	106	42	0	42	64
2050	73	33	106	42	0	42	64
2051	73	33	106	43	0	43	63
2052	73	33	106	43	0	43	63
2053	73	33	106	44	0	44	62
2054	73	33	106	44	0	44	62
2055	73	33	106	44	0	44	62
2056	73	33	106	45	0	45	61
2057	73	33	106	45	0	45	61
2058	73	33	106	46	0	46	60
2059	73	33	106	46	0	46	60
2060	73	33	106	47	0	47	59
2061	73	33	106	47	0	47	59
2062	73	33	106	47	0	47	59
2063	73	33	106	48	0	48	58
2064	73	33	106	48	0	48	58
2065	73	33	106	49	0	49	57
2066	73	33	106	49	0	49	57
2067	73	33	106	50	0	50	56
2068	73	33	106	50	0	50	56
2069	73	33	106	50	0	50	56
2070	73	33	106	51	0	51	55

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Highland Village's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	174	0	0	0
1	2015	16,500	174	(1)	102	103
2	2016	16,620	174	(2)	102	105
3	2017	16,740	175	(4)	103	106
4	2018	16,860	175	(5)	103	108
5-year Goal	2019	16,980	175	(6)	103	110
6	2020	17,100	174	0	104	104
7	2021	17,190	173	6	104	98
8	2022	17,280	172	13	104	92
9	2023	17,370	171	19	105	86
10-year Goal	2024	17,460	170	25	105	80

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Highland Village's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	16,500	18.00	0	30	30
2	2016	16,620	18.00	0	30	30
3	2017	16,740	18.00	0	31	31
4	2018	16,860	18.00	0	31	31
5-year Goal	2019	16,980	18.00	0	31	31
6	2020	17,100	17.80	1	31	30
7	2021	17,190	17.60	3	31	29
8	2022	17,280	17.40	4	32	28
9	2023	17,370	17.20	5	32	27
10-year Goal	2024	17,460	17.00	6	32	25

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 30 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing Increases**
    a. Utility reduced base price and greatly increased upper tier rate.
    b. This type of tiered rate structure price increase saves approximately 5.49% of total demand based on similar increases for other participating utilities in this project.
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Tiered Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	72	72
2016	72	72
2017	72	72
2018	72	72
2019	72	72
2020	73	73
2021	73	73
2022	73	73
2023	73	73
2024	73	73
2025	73	73
2026	74	74
2027	74	74
2028	74	74
2029	74	74
2030	74	74
2031	74	74
2032	74	74
2033	74	74
2034	74	74
2035	74	74
2036	74	74
2037	74	74
2038	74	74
2039	74	74
2040	73	73
2041	73	73
2042	73	73
2043	73	73
2044	73	73
2045	73	73
2046	73	73
2047	73	73
2048	73	73
2049	73	73
2050	73	73
2051	73	73
2052	73	73
2053	73	73
2054	73	73
2055	73	73
2056	73	73
2057	73	73
2058	73	73
2059	73	73
2060	73	73
2061	73	73
2062	73	73
2063	73	73
2064	73	73
2065	73	73
2066	73	73
2067	73	73
2068	73	73
2069	73	73
2070	73	73

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	16,500	13.00	30
2016	16,620	13.00	30
2017	16,740	13.00	31
2018	16,860	13.00	31
2019	16,980	13.00	31
2020	17,100	13.00	31
2021	17,190	13.00	31
2022	17,280	13.00	32
2023	17,370	13.00	32
2024	17,460	13.00	32

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 10.74% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 141 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	72	30	102	141	9	3	13	230
2017	72	31	103	141	9	4	13	230
2018	72	31	103	141	11	5	16	229
2019	72	31	103	142	13	6	18	227
2020	73	31	104	142	17	6	23	223
2021	73	31	104	142	18	6	24	222
2022	73	32	104	143	19	6	25	222
2023	73	32	105	143	20	6	26	221
2024	73	32	105	143	21	6	27	221
2025	73	32	105	143	22	6	29	220
2026	74	32	106	144	23	6	30	220
2027	74	32	106	144	25	6	31	219
2028	74	33	106	144	26	6	32	219
2029	74	33	107	145	27	6	33	218
2030	74	33	107	145	28	6	34	218
2031	74	33	107	145	29	6	35	217
2032	74	33	107	145	30	5	35	217
2033	74	33	107	145	31	4	35	216
2034	74	33	107	144	32	4	36	215
2035	74	33	107	144	33	3	36	215
2036	74	33	107	144	34	2	37	214
2037	74	33	107	144	35	2	37	214
2038	74	33	106	144	36	1	37	213
2039	74	33	106	144	37	1	38	213
2040	73	33	106	144	38	0	38	212

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	72	30	102	18	9	3	13	107
2017	72	31	103	18	9	4	13	107
2018	72	31	103	18	11	5	16	105
2019	72	31	103	18	13	6	18	103
2020	73	31	104	18	17	6	23	99
2021	73	31	104	18	18	6	24	98
2022	73	32	104	18	19	6	25	97
2023	73	32	105	18	20	6	26	96
2024	73	32	105	18	21	6	27	96
2025	73	32	105	18	22	6	29	95
2026	74	32	106	18	23	6	30	94
2027	74	32	106	18	25	6	31	93
2028	74	33	106	18	26	6	32	92
2029	74	33	107	18	27	6	33	92
2030	74	33	107	18	28	6	34	91
2031	74	33	107	18	29	6	35	90
2032	74	33	107	18	30	5	35	90
2033	74	33	107	18	31	4	35	89
2034	74	33	107	18	32	4	36	89
2035	74	33	107	18	33	3	36	88
2036	74	33	107	18	34	2	37	88
2037	74	33	107	18	35	2	37	88
2038	74	33	106	18	36	1	37	87
2039	74	33	106	18	37	1	38	87
2040	73	33	106	18	38	0	38	86

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 72 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	72	30	102	72	9	3	13	162
2017	72	31	103	72	9	4	13	161
2018	72	31	103	72	11	5	16	159
2019	72	31	103	72	13	6	18	157
2020	73	31	104	73	17	6	23	154
2021	73	31	104	73	18	6	24	153
2022	73	32	104	73	19	6	25	152
2023	73	32	105	73	20	6	26	152
2024	73	32	105	73	21	6	27	151
2025	73	32	105	73	22	6	29	150
2026	74	32	106	74	23	6	30	150
2027	74	32	106	74	25	6	31	149
2028	74	33	106	74	26	6	32	148
2029	74	33	107	74	27	6	33	148
2030	74	33	107	74	28	6	34	147
2031	74	33	107	74	29	6	35	146
2032	74	33	107	74	30	5	35	146
2033	74	33	107	74	31	4	35	145
2034	74	33	107	74	32	4	36	145
2035	74	33	107	74	33	3	36	144
2036	74	33	107	74	34	2	37	144
2037	74	33	107	74	35	2	37	143
2038	74	33	106	74	36	1	37	143
2039	74	33	106	74	37	1	38	142
2040	73	33	106	73	38	0	38	142

4. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Hurst Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Hurst's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Hurst's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Hurst's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Hurst with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year #	Year	Utility Population	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
0	2011	817,637	0	0	0	0	0	0	0
1	2012	844,884	5,393	N/A	5,393	832	0	832	4,561
2	2013	872,130	5,537	N/A	5,537	1,663	0	1,663	3,874
3	2014	899,377	5,836	N/A	5,836	2,495	0	2,495	3,341
4	2015	926,624	6,722	(923)	5,799	3,327	0	3,327	2,472
5	2016	951,497	10,359	(948)	9,411	4,159	0	4,159	5,252
6	2017	976,371	10,251	(973)	9,278	4,159	0	4,159	5,120
7	2018	1,001,244	10,000	(998)	9,002	4,990	0	4,990	4,012
8	2019	1,026,118	10,108	(1,022)	9,085	5,822	0	5,822	3,263
9	2020	1,050,991	10,245	(1,047)	9,197	7,486	0	7,486	1,712
10	2021	1,072,217	10,393	(1,068)	9,324	7,537	0	7,537	1,787
11	2022	1,093,444	10,503	(1,090)	9,413	7,589	0	7,589	1,824
12	2023	1,114,670	10,623	(1,111)	9,512	7,641	0	7,641	1,871
13	2024	1,135,896	10,739	(1,132)	9,607	7,693	0	7,693	1,914
14	2025	1,157,123	10,865	(1,153)	9,712	7,745	0	7,745	1,967
15	2026	1,178,349	11,006	(1,174)	9,832	7,797	0	7,797	2,036
16	2027	1,199,575	11,148	(1,195)	9,953	7,848	0	7,848	2,104
17	2028	1,220,801	11,307	(1,216)	10,091	7,900	0	7,900	2,191
18	2029	1,242,028	11,467	(1,238)	10,229	7,952	0	7,952	2,277
19	2030	1,263,254	11,626	(1,259)	10,367	8,004	0	8,004	2,364
20	2031	1,284,607	11,797	(1,280)	10,517	8,126	0	8,126	2,391
21	2032	1,305,960	11,968	(1,301)	10,667	8,249	0	8,249	2,418
22	2033	1,327,313	12,139	(1,323)	10,817	8,371	0	8,371	2,446
23	2034	1,348,666	12,311	(1,344)	10,967	8,494	0	8,494	2,473
24	2035	1,370,019	12,482	(1,365)	11,116	8,616	0	8,616	2,500
25	2036	1,391,371	12,653	(1,386)	11,266	8,739	0	8,739	2,528
26	2037	1,412,724	12,824	(1,408)	11,416	8,861	0	8,861	2,555
27	2038	1,434,077	12,995	(1,429)	11,566	8,984	0	8,984	2,582
28	2039	1,455,430	13,166	(1,450)	11,716	9,106	0	9,106	2,610
29	2040	1,476,783	13,337	(1,472)	11,866	9,229	0	9,229	2,637
30	2041	1,501,745	13,469	(1,496)	11,973	9,323	0	9,323	2,650
31	2042	1,526,707	13,602	(1,521)	12,080	9,418	0	9,418	2,663
32	2043	1,551,670	13,734	(1,546)	12,188	9,512	0	9,512	2,675
33	2044	1,576,632	13,866	(1,571)	12,295	9,607	0	9,607	2,688
34	2045	1,601,594	13,998	(1,596)	12,402	9,702	0	9,702	2,701
35	2046	1,626,556	14,131	(1,621)	12,510	9,796	0	9,796	2,714
36	2047	1,651,518	14,263	(1,646)	12,617	9,891	0	9,891	2,726
37	2048	1,676,481	14,395	(1,671)	12,725	9,985	0	9,985	2,739
38	2049	1,701,443	14,527	(1,695)	12,832	10,080	0	10,080	2,752
39	2050	1,726,405	14,660	(1,720)	12,939	10,175	0	10,175	2,765
40	2051	1,755,587	14,778	(1,749)	13,029	10,259	0	10,259	2,769
41	2052	1,784,768	14,897	(1,778)	13,118	10,344	0	10,344	2,774
42	2053	1,813,950	15,015	(1,808)	13,208	10,429	0	10,429	2,779
43	2054	1,843,131	15,134	(1,837)	13,297	10,514	0	10,514	2,783
44	2055	1,872,313	15,252	(1,866)	13,386	10,599	0	10,599	2,788
45	2056	1,901,495	15,370	(1,895)	13,476	10,683	0	10,683	2,792
46	2057	1,930,676	15,489	(1,924)	13,565	10,768	0	10,768	2,797
47	2058	1,959,858	15,607	(1,953)	13,655	10,853	0	10,853	2,802
48	2059	1,989,039	15,726	(1,982)	13,744	10,938	0	10,938	2,806
49	2060	2,018,221	15,844	(2,011)	13,833	11,023	0	11,023	2,811
50	2061	2,050,073	15,985	(2,043)	13,942	11,123	0	11,123	2,819
51	2062	2,081,925	16,125	(2,075)	14,050	11,223	0	11,223	2,827
52	2063	2,113,778	16,265	(2,106)	14,159	11,323	0	11,323	2,835
53	2064	2,145,630	16,405	(2,138)	14,267	11,424	0	11,424	2,843
54	2065	2,177,482	16,545	(2,170)	14,375	11,524	0	11,524	2,851
55	2066	2,209,334	16,685	(2,201)	14,484	11,624	0	11,624	2,860
56	2067	2,241,186	16,825	(2,233)	14,592	11,725	0	11,725	2,868
57	2068	2,273,039	16,966	(2,265)	14,701	11,825	0	11,825	2,876
58	2069	2,304,891	17,106	(2,297)	14,809	11,925	0	11,925	2,884
59	2070	2,336,743	17,246	(2,328)	14,917	12,025	0	12,025	2,892

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Hurst's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	157	0	0	0
1	2015	39,016	156	14	228	214
2	2016	39,213	155	29	240	212
3	2017	39,410	154	43	240	197
4	2018	39,606	153	58	240	182
5-year Goal	2019	39,803	152	73	240	168
6	2020	40,000	151	88	240	153
7	2021	40,100	150	102	240	138
8	2022	40,200	149	117	240	123
9	2023	40,300	148	132	240	108
10-year Goal	2024	40,400	147	147	240	93

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Hurst's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	7.00	0	0	0
1	2015	39,016	6.80	3	14	11
2	2016	39,213	6.60	6	14	9
3	2017	39,410	6.40	9	14	6
4	2018	39,606	6.20	12	14	3
5-year Goal	2019	39,803	6.00	15	15	0
6	2020	40,000	5.80	18	15	(3)
7	2021	40,100	5.60	20	15	(6)
8	2022	40,200	5.40	23	15	(9)
9	2023	40,300	5.20	26	15	(12)
10-year Goal	2024	40,400	5.00	29	15	(15)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 14 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Outdoor landscape evaluations for single family (SF) customers**
    a. 15 outdoor evaluations performed since 2014
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5. **Save Water Co. Commercial, Multi-family and Hotel Programs**[17]
    a. Project initiated in service area in 2015
    b. Save Water completed work on 746 multi-family units in 2016
    c. Average monthly savings of 1,684,162 gallons
    d. Annualized savings of 20.21 MG for the life of the retrofitted fixtures

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	W.I.S.E. Guys Audits	Save Water Co. Program	TOTAL SAVINGS
2009				0
2010				0
2011				0
2012				0
2013				0
2014	206	0.04		206
2015	206	0.07	8	214
2016	206	0.10	20	226
2017	206	0.07	20	226
2018	206	0.05	20	226
2019	206	0.02	20	226
2020	206	0.01	20	226
2021	206		20	226
2022	206		20	226
2023	206		20	226
2024	206		20	226
2025	206		20	226
2026	206		20	226
2027	206		20	226
2028	206		20	226
2029	206		20	226
2030	206		20	226
2031	205		20	226
2032	205		20	225
2033	205		20	225
2034	204		20	224
2035	204		20	224
2036	203		20	223
2037	203		20	223
2038	202		20	223
2039	202		20	222
2040	202		20	222
2041	201		20	222
2042	201		20	221
2043	201		20	221
2044	201		20	221
2045	200		20	221
2046	200		20	220
2047	200		20	220
2048	200		20	220
2049	200		20	220
2050	199		20	219
2051	199		20	219
2052	199		20	219
2053	199		20	219
2054	199		20	219
2055	199		20	219
2056	199		20	219
2057	199		20	219
2058	199		20	219
2059	199		20	219
2060	199		20	219
2061	199		20	219
2062	199		20	219
2063	199		20	219
2064	199		20	219
2065	199		20	219
2066	199		20	219
2067	199		20	219
2068	199		20	219
2069	199		20	219
2070	199		20	219

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	7.00	0
2015	39,016	6.00	14
2016	39,213	6.00	14
2017	39,410	6.00	14
2018	39,606	6.00	14
2019	39,803	6.00	15
2020	40,000	6.00	15
2021	40,100	6.00	15
2022	40,200	6.00	15
2023	40,300	6.00	15
2024	40,400	6.00	15

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[18]

---

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	226	14	241	30	33	6	40	231
2017	226	14	241	30	33	7	41	230
2018	226	14	241	30	40	9	49	222
2019	226	15	241	30	47	10	57	214
2020	226	15	241	30	60	11	71	199
2021	226	15	241	30	62	11	73	198
2022	226	15	241	30	64	11	75	196
2023	226	15	241	30	66	11	77	194
2024	226	15	241	30	67	11	79	192
2025	226	15	241	30	69	11	80	190
2026	226	15	241	30	71	11	82	189
2027	226	15	241	30	73	11	84	187
2028	226	15	241	30	75	11	86	185
2029	226	15	241	30	76	11	88	183
2030	226	15	241	30	78	11	89	181
2031	226	15	241	30	80	10	90	180
2032	225	15	240	30	82	9	91	179
2033	225	15	240	30	83	8	91	178
2034	224	15	239	30	85	7	92	177
2035	224	15	239	29	87	6	92	176
2036	223	15	238	29	89	4	93	175
2037	223	15	238	29	90	3	94	174
2038	223	15	238	29	92	2	94	173
2039	222	15	237	29	94	1	95	172
2040	222	15	237	29	95	0	95	170

2. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 45 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	226	14	241	45	33	6	40	246
2017	226	14	241	45	33	7	41	244
2018	226	14	241	45	40	9	49	237
2019	226	15	241	45	47	10	57	229
2020	226	15	241	45	60	11	71	214
2021	226	15	241	44	62	11	73	212
2022	226	15	241	44	64	11	75	210
2023	226	15	241	44	66	11	77	209
2024	226	15	241	44	67	11	79	207
2025	226	15	241	44	69	11	80	205
2026	226	15	241	44	71	11	82	203
2027	226	15	241	44	73	11	84	201
2028	226	15	241	44	75	11	86	200
2029	226	15	241	44	76	11	88	198
2030	226	15	241	44	78	11	89	196
2031	226	15	241	44	80	10	90	195
2032	225	15	240	44	82	9	91	194
2033	225	15	240	44	83	8	91	193
2034	224	15	239	44	85	7	92	192
2035	224	15	239	44	87	6	92	190
2036	223	15	238	44	89	4	93	189
2037	223	15	238	44	90	3	94	188
2038	223	15	238	44	92	2	94	187
2039	222	15	237	44	94	1	95	186
2040	222	15	237	44	95	0	95	185

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Irving Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Irving's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Irving's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Irving's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8][9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Irving with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,977	86	2,064	108	41	149	1,915
2016	2,243	88	2,331	135	51	186	2,145
2017	2,260	90	2,349	135	61	196	2,153
2018	2,275	92	2,366	163	71	234	2,133
2019	2,290	93	2,383	190	81	271	2,112
2020	2,306	95	2,401	244	92	335	2,065
2021	2,321	96	2,417	262	92	353	2,064
2022	2,337	97	2,434	280	92	372	2,063
2023	2,354	98	2,452	298	92	390	2,062
2024	2,370	99	2,469	316	92	408	2,061
2025	2,386	100	2,486	334	92	426	2,060
2026	2,403	100	2,503	352	92	444	2,059
2027	2,419	101	2,520	370	92	462	2,058
2028	2,435	102	2,537	388	92	480	2,057
2029	2,452	103	2,555	407	92	498	2,056
2030	2,468	104	2,572	425	92	516	2,056
2031	2,465	104	2,569	440	82	523	2,046
2032	2,462	104	2,566	456	73	529	2,037
2033	2,460	104	2,563	472	64	536	2,028
2034	2,457	104	2,561	487	55	542	2,018
2035	2,454	104	2,558	503	46	549	2,009
2036	2,451	104	2,555	519	37	555	2,000
2037	2,448	104	2,552	534	27	562	1,990
2038	2,446	104	2,549	550	18	568	1,981
2039	2,443	104	2,547	566	9	575	1,972
2040	2,440	104	2,544	581	0	581	1,962
2041	2,438	104	2,542	587	0	587	1,955
2042	2,437	104	2,541	594	0	594	1,947
2043	2,435	104	2,539	600	0	600	1,940
2044	2,434	104	2,538	606	0	606	1,932
2045	2,432	104	2,536	612	0	612	1,924
2046	2,431	104	2,535	618	0	618	1,917
2047	2,429	104	2,533	624	0	624	1,909
2048	2,428	104	2,532	630	0	630	1,902
2049	2,426	104	2,530	636	0	636	1,894
2050	2,425	104	2,528	642	0	642	1,886
2051	2,424	104	2,528	648	0	648	1,880
2052	2,424	104	2,528	655	0	655	1,873
2053	2,424	104	2,527	661	0	661	1,867
2054	2,423	104	2,527	667	0	667	1,860
2055	2,423	104	2,527	673	0	673	1,853
2056	2,423	104	2,526	680	0	680	1,847
2057	2,422	104	2,526	686	0	686	1,840
2058	2,422	104	2,526	692	0	692	1,833
2059	2,422	104	2,526	699	0	699	1,827
2060	2,421	104	2,525	705	0	705	1,820
2061	2,421	104	2,525	711	0	711	1,814
2062	2,421	104	2,525	718	0	718	1,807
2063	2,421	104	2,525	724	0	724	1,801
2064	2,421	104	2,525	731	0	731	1,794
2065	2,421	104	2,525	737	0	737	1,788
2066	2,421	104	2,525	743	0	743	1,782
2067	2,421	104	2,525	750	0	750	1,775
2068	2,421	104	2,525	756	0	756	1,769
2069	2,421	104	2,525	763	0	763	1,762
2070	2,421	104	2,525	769	0	769	1,756

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Irving's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	170	0	0	0
1	2015	236,607	170	35	2,064	2,029
2	2016	241,436	169	70	2,331	2,261
3	2017	246,265	169	108	2,349	2,242
4	2018	251,094	168	147	2,366	2,220
5-year Goal	2019	255,923	168	187	2,383	2,197
6	2020	260,752	168	228	2,401	2,172
7	2021	263,127	167	269	2,417	2,149
8	2022	265,502	167	310	2,434	2,124
9	2023	267,876	166	352	2,452	2,100
10-year Goal	2024	270,251	166	395	2,469	2,074

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Irving's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	236,607	16.00	0	86	86
2	2016	241,436	16.00	0	88	88
3	2017	246,265	16.00	0	90	90
4	2018	251,094	16.00	0	92	92
5-year Goal	2019	255,923	16.00	0	93	93
6	2020	260,752	16.00	0	95	95
7	2021	263,127	16.00	0	96	96
8	2022	265,502	16.00	0	97	97
9	2023	267,876	16.00	0	98	98
10-year Goal	2024	270,251	16.00	0	99	99

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of MG 86 annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[17]
      i. 8.0% increase in 2015
      ii. 7.0% increase in 2016
   b. Estimated customer demand reduction of 3.0%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 9.47% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Outdoor landscape evaluations for single family (SF) customers**
    a. 900 outdoor evaluations performed since 2010
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
    a. Project initiated in service area in 2014
    b. Save Water completed work on 841 multi-family units in 2016
    c. Average monthly savings of 1,963,615 gallons
    d. Annualized savings of 24 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    g. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Save Water Co. Program	Outdoor Audits	Water Rate Increases	TOTAL SAVINGS
2012			1.2		1
2013			2.2		2
2014	1,658	16	2.9		1,677
2015	1,671	21	3.4	282	1,977
2016	1,683	24	3.6	533	2,243
2017	1,695	24	3.6	537	2,260
2018	1,708	24	2.4	541	2,275
2019	1,720	24	1.4	545	2,290
2020	1,732	24	0.7	549	2,306
2021	1,745	24	0.2	553	2,321
2022	1,757	24		557	2,337
2023	1,770	24		561	2,354
2024	1,782	24		565	2,370
2025	1,794	24		568	2,386
2026	1,807	24		572	2,403
2027	1,819	24		576	2,419
2028	1,832	24		580	2,435
2029	1,844	24		584	2,452
2030	1,856	24		588	2,468
2031	1,854	24		587	2,465
2032	1,852	24		587	2,462
2033	1,850	24		586	2,460
2034	1,848	24		585	2,457
2035	1,846	24		585	2,454
2036	1,844	24		584	2,451
2037	1,841	24		583	2,448
2038	1,839	24		583	2,446
2039	1,837	24		582	2,443
2040	1,835	24		581	2,440
2041	1,834	24		581	2,438
2042	1,833	24		581	2,437
2043	1,832	24		580	2,435
2044	1,830	24		580	2,434
2045	1,829	24		579	2,432
2046	1,828	24		579	2,431
2047	1,827	24		579	2,429
2048	1,826	24		578	2,428
2049	1,825	24		578	2,426
2050	1,823	24		578	2,425
2051	1,823	24		578	2,424
2052	1,823	24		577	2,424
2053	1,823	24		577	2,424
2054	1,822	24		577	2,423
2055	1,822	24		577	2,423
2056	1,822	24		577	2,423
2057	1,822	24		577	2,422
2058	1,821	24		577	2,422
2059	1,821	24		577	2,422
2060	1,821	24		577	2,421
2061	1,821	24		577	2,421
2062	1,821	24		577	2,421
2063	1,821	24		577	2,421
2064	1,821	24		577	2,421
2065	1,821	24		577	2,421
2066	1,821	24		577	2,421
2067	1,821	24		577	2,421
2068	1,821	24		577	2,421
2069	1,821	24		577	2,421
2070	1,821	24		577	2,421

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	236,607	15.00	86
2016	241,436	15.00	88
2017	246,265	15.00	90
2018	251,094	15.00	92
2019	255,923	15.00	93
2020	260,752	15.00	95
2021	263,127	15.00	96
2022	265,502	15.00	97
2023	267,876	15.00	98
2024	270,251	15.00	99

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2,243	88	2,331	238	135	51	186	2,383
2017	2,260	90	2,349	240	135	61	196	2,393
2018	2,275	92	2,366	242	163	71	234	2,374
2019	2,290	93	2,383	243	190	81	271	2,356
2020	2,306	95	2,401	245	244	92	335	2,311
2021	2,321	96	2,417	247	262	92	353	2,311
2022	2,337	97	2,434	249	280	92	372	2,312
2023	2,354	98	2,452	250	298	92	390	2,312
2024	2,370	99	2,469	252	316	92	408	2,313
2025	2,386	100	2,486	254	334	92	426	2,314
2026	2,403	100	2,503	256	352	92	444	2,315
2027	2,419	101	2,520	257	370	92	462	2,316
2028	2,435	102	2,537	259	388	92	480	2,317
2029	2,452	103	2,555	261	407	92	498	2,317
2030	2,468	104	2,572	263	425	92	516	2,318
2031	2,465	104	2,569	262	440	82	523	2,309
2032	2,462	104	2,566	262	456	73	529	2,299
2033	2,460	104	2,563	262	472	64	536	2,289
2034	2,457	104	2,561	261	487	55	542	2,280
2035	2,454	104	2,558	261	503	46	549	2,270
2036	2,451	104	2,555	261	519	37	555	2,261
2037	2,448	104	2,552	261	534	27	562	2,251
2038	2,446	104	2,549	260	550	18	568	2,241
2039	2,443	104	2,547	260	566	9	575	2,232
2040	2,440	104	2,544	260	581	0	581	2,222

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Kaufman Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Kaufman's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Kaufman's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Kaufman's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Kaufman with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	0	0	0	1	1	(1)
2016	1.0	0	1	1	1	1	(0)
2017	1.1	0	1	1	1	2	(1)
2018	1.1	0	1	1	1	2	(1)
2019	1.1	0	1	1	1	2	(1)
2020	1.1	0	1	1	2	3	(1)
2021	1.2	0	1	1	2	3	(2)
2022	1.2	0	1	1	2	3	(2)
2023	1.2	0	1	1	2	3	(2)
2024	1.2	0	1	2	2	3	(2)
2025	1.2	0	1	2	2	3	(2)
2026	1.3	0	1	2	2	4	(2)
2027	1.3	0	1	2	2	4	(2)
2028	1.3	0	1	2	2	4	(3)
2029	1.3	0	1	2	2	4	(3)
2030	1.4	0	1	3	2	4	(3)
2031	1.4	0	1	3	1	4	(3)
2032	1.4	0	1	3	1	4	(3)
2033	1.4	0	1	3	1	4	(3)
2034	1.5	0	1	3	1	4	(3)
2035	1.5	0	1	4	1	4	(3)
2036	1.5	0	2	4	1	4	(3)
2037	1.6	0	2	4	0	4	(3)
2038	1.6	0	2	4	0	4	(3)
2039	1.6	0	2	4	0	5	(3)
2040	1.6	0	2	5	0	5	(3)
2041	1.7	0	2	5	0	5	(3)
2042	1.8	0	2	6	0	6	(4)
2043	1.9	0	2	6	0	6	(4)
2044	2.0	0	2	7	0	7	(5)
2045	2.0	0	2	7	0	7	(5)
2046	2.1	0	2	7	0	7	(5)
2047	2.2	0	2	8	0	8	(6)
2048	2.3	0	2	8	0	8	(6)
2049	2.4	0	2	9	0	9	(7)
2050	2.5	0	2	9	0	9	(7)
2051	2.5	0	3	10	0	10	(7)
2052	2.6	0	3	11	0	11	(8)
2053	2.7	0	3	11	0	11	(8)
2054	2.7	0	3	12	0	12	(9)
2055	2.8	0	3	12	0	12	(9)
2056	2.9	0	3	13	0	13	(10)
2057	3.0	0	3	13	0	13	(10)
2058	3.0	0	3	14	0	14	(11)
2059	3.1	0	3	14	0	14	(11)
2060	3.2	0	3	15	0	15	(12)
2061	3.2	0	3	16	0	16	(12)
2062	3.3	0	3	16	0	16	(13)
2063	3.4	0	3	17	0	17	(14)
2064	3.5	0	3	18	0	18	(14)
2065	3.5	0	4	19	0	19	(15)
2066	3.6	0	4	19	0	19	(16)
2067	3.7	0	4	20	0	20	(16)
2068	3.7	0	4	21	0	21	(17)
2069	3.8	0	4	21	0	21	(18)
2070	3.9	0	4	22	0	22	(18)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Kaufman's quantified savings from its implemented activities compare with 5- 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	120	0	0	0
1	2015	7,156	120	1	0	(1)
2	2016	7,325	119	2	1	(1)
3	2017	7,494	119	3	1	(2)
4	2018	7,662	118	4	1	(3)
5-year Goal	2019	7,831	118	6	1	(5)
6	2020	8,000	117	8	1	(6)
7	2021	8,200	117	10	1	(8)
8	2022	8,400	116	12	1	(10)
9	2023	8,600	116	14	1	(13)
10-year Goal	2024	8,800	115	16	1	(15)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Kaufman's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	7,156	13.60	4	0	(4)
2	2016	7,325	12.20	7	0	(7)
3	2017	7,494	10.80	11	0	(11)
4	2018	7,662	9.40	16	0	(16)
5-year Goal	2019	7,831	8.00	20	0	(20)
6	2020	8,000	7.80	21	0	(21)
7	2021	8,200	7.60	22	0	(22)
8	2022	8,400	7.40	23	0	(23)
9	2023	8,600	7.20	24	0	(24)
10-year Goal	2024	8,800	7.00	26	0	(26)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 1.75% increase in 2016
    b. Estimated customer demand reduction of .35%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015		0
2016	1.04	1.0
2017	1.06	1.1
2018	1.08	1.1
2019	1.11	1.1
2020	1.13	1.1
2021	1.15	1.2
2022	1.17	1.2
2023	1.20	1.2
2024	1.22	1.2
2025	1.24	1.2
2026	1.26	1.3
2027	1.28	1.3
2028	1.31	1.3
2029	1.33	1.3
2030	1.35	1.4
2031	1.38	1.4
2032	1.41	1.4
2033	1.44	1.4
2034	1.47	1.5
2035	1.50	1.5
2036	1.53	1.5
2037	1.56	1.6
2038	1.59	1.6
2039	1.62	1.6
2040	1.64	1.6
2041	1.73	1.7
2042	1.81	1.8
2043	1.89	1.9
2044	1.97	2.0
2045	2.05	2.0
2046	2.13	2.1
2047	2.21	2.2
2048	2.29	2.3
2049	2.37	2.4
2050	2.45	2.5
2051	2.52	2.5
2052	2.60	2.6
2053	2.67	2.7
2054	2.74	2.7
2055	2.81	2.8
2056	2.88	2.9
2057	2.95	3.0
2058	3.02	3.0
2059	3.10	3.1
2060	3.17	3.2
2061	3.24	3.2
2062	3.31	3.3
2063	3.38	3.4
2064	3.45	3.5
2065	3.53	3.5
2066	3.60	3.6
2067	3.67	3.7
2068	3.74	3.7
2069	3.81	3.8
2070	3.89	3.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	7,156	15.00	0
2016	7,325	15.00	0
2017	7,494	15.00	0
2018	7,662	15.00	0
2019	7,831	15.00	0
2020	8,000	15.00	0
2021	8,200	15.00	0
2022	8,400	15.00	0
2023	8,600	15.00	0
2024	8,800	15.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region C savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 24 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	0	1	24	1	1	1	23
2017	1	0	1	24	1	1	2	24
2018	1	0	1	25	1	1	2	24
2019	1	0	1	25	1	1	2	24
2020	1	0	1	26	1	2	3	24
2021	1	0	1	26	1	2	3	25
2022	1	0	1	27	1	2	3	25
2023	1	0	1	27	1	2	3	25
2024	1	0	1	28	2	2	3	26
2025	1	0	1	28	2	2	3	26
2026	1	0	1	29	2	2	4	27
2027	1	0	1	29	2	2	4	27
2028	1	0	1	30	2	2	4	27
2029	1	0	1	30	2	2	4	28
2030	1	0	1	31	3	2	4	28
2031	1	0	1	32	3	1	4	29
2032	1	0	1	32	3	1	4	29
2033	1	0	1	33	3	1	4	30
2034	1	0	1	34	3	1	4	31
2035	1	0	1	34	4	1	4	31
2036	2	0	2	35	4	1	4	32
2037	2	0	2	36	4	0	4	33
2038	2	0	2	36	4	0	4	33
2039	2	0	2	37	4	0	5	34
2040	2	0	2	38	5	0	5	35

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	0	1	4	1	1	1	4
2017	1	0	1	4	1	1	2	4
2018	1	0	1	4	1	1	2	3
2019	1	0	1	4	1	1	2	3
2020	1	0	1	4	1	2	3	3
2021	1	0	1	4	1	2	3	3
2022	1	0	1	4	1	2	3	3
2023	1	0	1	5	1	2	3	3
2024	1	0	1	5	2	2	3	3
2025	1	0	1	5	2	2	3	3
2026	1	0	1	5	2	2	4	3
2027	1	0	1	5	2	2	4	2
2028	1	0	1	5	2	2	4	2
2029	1	0	1	5	2	2	4	2
2030	1	0	1	5	3	2	4	2
2031	1	0	1	5	3	1	4	2
2032	1	0	1	5	3	1	4	3
2033	1	0	1	6	3	1	4	3
2034	1	0	1	6	3	1	4	3
2035	1	0	1	6	4	1	4	3
2036	2	0	2	6	4	1	4	3
2037	2	0	2	6	4	0	4	3
2038	2	0	2	6	4	0	4	3
2039	2	0	2	6	4	0	5	3
2040	2	0	2	6	5	0	5	3

3. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Keller Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Keller's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Keller's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Keller's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. We are not aware of all activities that are ongoing. Some activities within a utility's service area are implemented on a micro-scale that we cannot yet quantify. Individual households and businesses may be implementing conservation measures that we do not know about and therefore cannot include in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Keller with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	307	134	441	24	9	32	408
2016	448	135	583	30	11	41	543
2017	451	136	587	30	13	43	545
2018	454	137	591	35	15	51	541
2019	458	138	596	41	18	59	537
2020	461	139	600	53	20	73	527
2021	464	140	604	57	20	77	527
2022	467	141	608	61	20	81	527
2023	470	142	612	65	20	85	527
2024	473	143	616	69	20	89	528
2025	476	145	620	73	20	92	528
2026	479	146	624	76	20	96	528
2027	482	147	628	80	20	100	528
2028	485	148	632	84	20	104	528
2029	488	149	636	88	20	108	529
2030	491	150	641	92	20	112	529
2031	490	150	640	95	18	113	527
2032	490	150	640	99	16	115	525
2033	490	150	640	102	14	116	524
2034	490	150	639	106	12	118	522
2035	489	150	639	109	10	119	520
2036	489	150	639	112	8	120	518
2037	489	150	639	116	6	122	517
2038	488	150	638	119	4	123	515
2039	488	150	638	123	2	125	513
2040	488	150	638	126	0	126	512
2041	488	150	638	127	0	127	510
2042	488	150	637	129	0	129	509
2043	487	150	637	130	0	130	507
2044	487	150	637	131	0	131	506
2045	487	150	637	133	0	133	504
2046	487	150	637	134	0	134	503
2047	487	150	637	135	0	135	501
2048	487	150	636	137	0	137	500
2049	486	150	636	138	0	138	498
2050	486	150	636	139	0	139	497
2051	486	150	636	141	0	141	495
2052	486	150	636	142	0	142	494
2053	486	150	636	144	0	144	492
2054	486	150	636	145	0	145	491
2055	486	150	636	146	0	146	489
2056	486	150	636	148	0	148	488
2057	486	150	636	149	0	149	486
2058	486	150	636	151	0	151	485
2059	486	150	636	152	0	152	483
2060	486	150	635	153	0	153	482
2061	486	150	635	155	0	155	481
2062	486	150	635	156	0	156	479
2063	486	150	635	158	0	158	478
2064	486	150	635	159	0	159	476
2065	486	150	635	161	0	161	475
2066	486	150	635	162	0	162	474
2067	486	150	635	163	0	163	472
2068	486	150	635	165	0	165	471
2069	486	150	635	166	0	166	469
2070	486	150	635	168	0	168	468

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Keller's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	207	0	0	0
1	2015	45,758	206	13	441	427
2	2016	46,139	205	27	583	556
3	2017	46,520	205	41	587	547
4	2018	46,901	204	55	591	537
5-year Goal	2019	47,282	203	69	596	527
6	2020	47,663	202	80	600	520
7	2021	48,028	202	91	604	513
8	2022	48,392	201	102	608	505
9	2023	48,757	201	114	612	498
10-year Goal	2024	49,122	200	126	616	491

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Keller's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	45,758	16.00	0	134	134
2	2016	46,139	16.00	0	135	135
3	2017	46,520	16.00	0	136	136
4	2018	46,901	16.00	0	137	137
5-year Goal	2019	47,282	16.00	0	138	138
6	2020	47,663	16.00	0	139	139
7	2021	48,028	16.00	0	140	140
8	2022	48,392	16.00	0	141	141
9	2023	48,757	16.00	0	142	142
10-year Goal	2024	49,122	16.00	0	143	143

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 134 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 18% increase in 2016
    b. Estimated customer demand reduction of 3.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014	305		305
2015	307		307
2016	309	139	448
2017	311	140	451
2018	313	141	454
2019	316	142	458
2020	318	143	461
2021	320	144	464
2022	322	145	467
2023	324	146	470
2024	326	147	473
2025	328	148	476
2026	330	149	479
2027	332	149	482
2028	334	150	485
2029	336	151	488
2030	338	152	491
2031	338	152	490
2032	338	152	490
2033	338	152	490
2034	338	152	490
2035	337	152	489
2036	337	152	489
2037	337	152	489
2038	337	152	488
2039	337	152	488
2040	336	151	488
2041	336	151	488
2042	336	151	488
2043	336	151	487
2044	336	151	487
2045	336	151	487
2046	336	151	487
2047	336	151	487
2048	336	151	487
2049	335	151	486
2050	335	151	486
2051	335	151	486
2052	335	151	486
2053	335	151	486
2054	335	151	486
2055	335	151	486
2056	335	151	486
2057	335	151	486
2058	335	151	486
2059	335	151	486
2060	335	151	486
2061	335	151	486
2062	335	151	486
2063	335	151	486
2064	335	151	486
2065	335	151	486
2066	335	151	486
2067	335	151	486
2068	335	151	486
2069	335	151	486
2070	335	151	486

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2014	44,574	8.00	130
2015	45,758	8.00	134
2016	46,139	8.00	135
2017	46,520	8.00	136
2018	46,901	8.00	137
2019	47,282	8.00	138
2020	47,663	8.00	139
2021	48,028	8.00	140
2022	48,392	8.00	141
2023	48,757	8.00	142

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	448	135	583	52	30	11	41	594
2017	451	136	587	52	30	13	43	597
2018	454	137	591	53	35	15	51	593
2019	458	138	596	53	41	18	59	589
2020	461	139	600	53	53	20	73	580
2021	464	140	604	54	57	20	77	580
2022	467	141	608	54	61	20	81	581
2023	470	142	612	54	65	20	85	582
2024	473	143	616	55	69	20	89	582
2025	476	145	620	55	73	20	92	583
2026	479	146	624	55	76	20	96	583
2027	482	147	628	56	80	20	100	584
2028	485	148	632	56	84	20	104	584
2029	488	149	636	56	88	20	108	585
2030	491	150	641	57	92	20	112	585
2031	490	150	640	57	95	18	113	584
2032	490	150	640	57	99	16	115	582
2033	490	150	640	57	102	14	116	580
2034	490	150	639	57	106	12	118	578
2035	489	150	639	57	109	10	119	577
2036	489	150	639	56	112	8	120	575
2037	489	150	639	56	116	6	122	573
2038	488	150	638	56	119	4	123	571
2039	488	150	638	56	123	2	125	570
2040	488	150	638	56	126	0	126	568

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Lancaster Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Lancaster's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Lancaster's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Lancaster's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Lancaster with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	30	127	157	15	5	20	137
2016	31	132	163	19	7	26	137
2017	32	136	168	19	8	27	141
2018	32	140	173	23	9	32	141
2019	33	144	178	26	11	37	140
2020	34	148	183	34	12	46	137
2021	35	153	188	38	12	50	139
2022	36	157	193	41	12	53	140
2023	37	162	199	45	12	57	142
2024	38	166	204	48	12	60	144
2025	39	171	210	52	12	64	146
2026	40	175	215	55	12	67	148
2027	41	180	221	59	12	71	150
2028	42	184	226	62	12	74	152
2029	43	189	232	66	12	78	154
2030	44	193	237	69	12	81	156
2031	45	197	242	73	11	84	158
2032	45	201	246	78	10	87	159
2033	46	204	250	82	8	90	160
2034	47	208	255	86	7	93	161
2035	48	211	259	90	6	96	162
2036	48	215	263	95	5	99	164
2037	49	218	267	99	4	103	165
2038	50	222	272	103	2	106	166
2039	51	225	276	108	1	109	167
2040	51	229	280	112	0	112	169
2041	52	232	284	114	0	114	169
2042	53	234	287	117	0	117	170
2043	53	237	290	120	0	120	171
2044	54	239	293	122	0	122	171
2045	54	242	296	125	0	125	172
2046	55	245	300	127	0	127	172
2047	56	247	303	130	0	130	173
2048	56	250	306	132	0	132	174
2049	57	252	309	135	0	135	174
2050	57	255	312	138	0	138	175
2051	58	258	315	140	0	140	175
2052	58	260	319	143	0	143	175
2053	59	263	322	146	0	146	176
2054	60	266	325	149	0	149	176
2055	60	268	328	152	0	152	176
2056	61	271	331	155	0	155	176
2057	61	273	335	158	0	158	177
2058	62	276	338	161	0	161	177
2059	62	279	341	164	0	164	177
2060	63	281	344	167	0	167	178
2061	64	284	347	170	0	170	178
2062	64	286	351	173	0	173	178
2063	65	289	354	176	0	176	178
2064	65	292	357	179	0	179	178
2065	66	294	360	182	0	182	178
2066	66	297	363	186	0	186	178
2067	67	299	366	189	0	189	178
2068	68	302	370	192	0	192	178
2069	68	305	373	195	0	195	178
2070	69	307	376	198	0	198	178

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Lancaster's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	129	0	0	0
1	2015	38,801	129	6	157	152
2	2016	40,078	128	12	163	151
3	2017	41,354	128	18	168	149
4	2018	42,631	127	25	173	148
5-year Goal	2019	43,907	127	32	178	145
6	2020	45,184	127	40	183	143
7	2021	46,555	126	48	188	140
8	2022	47,926	126	56	193	137
9	2023	49,297	125	65	199	134
10-year Goal	2024	50,668	125	74	204	130

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Lancaster's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	38,801	15.00	0	127	127
2	2016	40,078	15.00	0	132	132
3	2017	41,354	15.00	0	136	136
4	2018	42,631	15.00	0	140	140
5-year Goal	2019	43,907	15.00	0	144	144
6	2020	45,184	15.00	0	148	148
7	2021	46,555	15.00	0	153	153
8	2022	47,926	15.00	0	157	157
9	2023	49,297	15.00	0	162	162
10-year Goal	2024	50,668	15.00	0	166	166

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 127 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 6.8% increase in 2014
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5 which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. WaterWise Take-home Kits

a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
b. Conservative 5-year useful life for all items in kit
c. 15% adoption rate assumed

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	Water Rate Increase	TOTAL SAVINGS
2012	0.2		0.2
2013	0.4		0.4
2014	0.5	28.4	29
2015	0.6	29.3	30
2016	0.7	30.3	31
2017	0.4	31.3	32
2018	0.3	32.2	32
2019	0.1	33.2	33
2020	0.04	34.1	34
2021		35.1	35
2022		36.0	36
2023		37.0	37
2024		37.9	38
2025		38.9	39
2026		39.8	40
2027		40.8	41
2028		41.7	42
2029		42.7	43
2030		43.6	44
2031		44.6	45
2032		45.4	45
2033		46.1	46
2034		46.9	47
2035		47.6	48
2036		48.4	48
2037		49.1	49
2038		49.9	50
2039		50.6	51
2040		51.4	51
2041		52.1	52
2042		52.7	53
2043		53.3	53
2044		53.8	54
2045		54.4	54
2046		55.0	55
2047		55.5	56
2048		56.1	56
2049		56.6	57
2050		57.2	57
2051		57.8	58
2052		58.3	58
2053		58.9	59
2054		59.5	60
2055		60.1	60
2056		60.7	61
2057		61.2	61
2058		61.8	62
2059		62.4	62
2060		63.0	63
2061		63.6	64
2062		64.2	64
2063		64.7	65
2064		65.3	65
2065		65.9	66
2066		66.5	66
2067		67.1	67
2068		67.7	68
2069		68.3	68
2070		68.8	69

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	38,801	6.00	127
2016	40,078	6.00	132
2017	41,354	6.00	136
2018	42,631	6.00	140
2019	43,907	6.00	144
2020	45,184	6.00	148
2021	46,555	6.00	153
2022	47,926	6.00	157
2023	49,297	6.00	162
2024	50,668	6.00	166

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 179 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	31	132	163	179	19	7	26	316
2017	32	136	168	184	19	8	27	325
2018	32	140	173	189	23	9	32	330
2019	33	144	178	195	26	11	37	335
2020	34	148	183	200	34	12	46	337
2021	35	153	188	206	38	12	50	344
2022	36	157	193	211	41	12	53	352
2023	37	162	199	217	45	12	57	359
2024	38	166	204	222	48	12	60	367
2025	39	171	210	228	52	12	64	374
2026	40	175	215	233	55	12	67	381
2027	41	180	221	239	59	12	71	389
2028	42	184	226	244	62	12	74	396
2029	43	189	232	249	66	12	78	404
2030	44	193	237	255	69	12	81	411
2031	45	197	242	259	73	11	84	417
2032	45	201	246	263	78	10	87	422
2033	46	204	250	268	82	8	90	428
2034	47	208	255	272	86	7	93	433
2035	48	211	259	276	90	6	96	439
2036	48	215	263	281	95	5	99	444
2037	49	218	267	285	99	4	103	450
2038	50	222	272	289	103	2	106	456
2039	51	225	276	294	108	1	109	461
2040	51	229	280	298	112	0	112	467

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	31	132	163	30	19	7	26	167
2017	32	136	168	31	19	8	27	171
2018	32	140	173	32	23	9	32	172
2019	33	144	178	33	26	11	37	173
2020	34	148	183	34	34	12	46	170
2021	35	153	188	34	38	12	50	173
2022	36	157	193	35	41	12	53	176
2023	37	162	199	36	45	12	57	179
2024	38	166	204	37	48	12	60	182
2025	39	171	210	38	52	12	64	184
2026	40	175	215	39	55	12	67	187
2027	41	180	221	40	59	12	71	190
2028	42	184	226	41	62	12	74	193
2029	43	189	232	42	66	12	78	196
2030	44	193	237	43	69	12	81	199
2031	45	197	242	43	73	11	84	201
2032	45	201	246	44	78	10	87	203
2033	46	204	250	45	82	8	90	205
2034	47	208	255	46	86	7	93	207
2035	48	211	259	46	90	6	96	209
2036	48	215	263	47	95	5	99	211
2037	49	218	267	48	99	4	103	213
2038	50	222	272	48	103	2	106	215
2039	51	225	276	49	108	1	109	217
2040	51	229	280	50	112	0	112	219

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Little Elm Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in 5-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Little Elm's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Little Elm's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Little Elm's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Little Elm with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	102	28	129	2	3	5	124
2016	114	28	142	3	4	6	136
2017	126	28	154	3	5	7	147
2018	128	29	157	3	5	8	148
2019	130	29	159	4	6	10	149
2020	131	29	161	5	7	11	149
2021	133	31	164	5	7	12	152
2022	134	33	167	6	7	13	155
2023	136	35	171	6	7	13	158
2024	138	37	174	7	7	14	160
2025	139	38	177	7	7	14	163
2026	141	40	181	8	7	15	166
2027	142	42	184	8	7	15	169
2028	144	44	188	9	7	16	172
2029	145	46	191	10	7	16	174
2030	147	47	194	10	7	17	177
2031	147	49	196	11	6	17	179
2032	147	50	197	11	5	17	181
2033	147	52	198	12	5	16	182
2034	147	53	200	12	4	16	184
2035	147	55	201	13	3	16	185
2036	147	56	203	13	3	16	187
2037	146	58	204	14	2	16	189
2038	146	59	206	14	1	15	190
2039	146	61	207	15	1	15	192
2040	146	62	208	15	0	15	193
2041	146	62	209	15	0	15	193
2042	146	63	209	16	0	16	193
2043	146	63	209	16	0	16	193
2044	146	64	210	17	0	17	193
2045	146	64	210	17	0	17	193
2046	146	64	210	18	0	18	192
2047	146	65	211	18	0	18	192
2048	146	65	211	19	0	19	192
2049	146	65	211	19	0	19	192
2050	146	66	212	20	0	20	192
2051	146	66	212	20	0	20	191
2052	146	66	212	21	0	21	191
2053	146	66	212	21	0	21	190
2054	146	66	212	22	0	22	190
2055	146	66	212	22	0	22	189
2056	146	66	211	23	0	23	189
2057	146	66	211	23	0	23	188
2058	146	66	211	24	0	24	188
2059	146	66	211	24	0	24	187
2060	146	66	211	25	0	25	187
2061	146	66	211	25	0	25	186
2062	146	66	211	26	0	26	186
2063	146	66	211	26	0	26	185
2064	146	66	211	27	0	27	185
2065	146	66	211	27	0	27	184
2066	146	66	211	28	0	28	184
2067	146	66	211	28	0	28	183
2068	146	66	211	29	0	29	183
2069	146	66	211	29	0	29	182
2070	146	66	211	30	0	30	182

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Little Elm's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	140	0	0	0
1	2015	38,341	140	0	129	129
2	2016	38,673	140	0	142	142
3	2017	39,005	140	0	154	154
4	2018	39,336	140	0	157	157
5-year Goal	2019	39,668	140	0	159	159
6	2020	40,000	140	0	161	161
7	2021	42,500	140	0	164	164
8	2022	45,000	140	0	167	167
9	2023	47,500	140	0	171	171
10-year Goal	2024	50,000	140	0	174	174

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Little Elm's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	13.00	0	0	0
1	2015	38,341	12.80	3	28	25
2	2016	38,673	12.60	6	28	23
3	2017	39,005	12.40	9	28	20
4	2018	39,336	12.20	11	29	17
5-year Goal	2019	39,668	12.00	14	29	14
6	2020	40,000	12.00	15	29	15
7	2021	42,500	12.00	16	31	16
8	2022	45,000	12.00	16	33	16
9	2023	47,500	12.00	17	35	17
10-year Goal	2024	50,000	12.00	18	37	18

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 28 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 4.0% increase in 2016
        ii. 4.0% increase in 2017
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Showerhead Distribution (SF)**
    a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
    b. 5-year useful life
        i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increases	Low Flow Showerheads (SF)	TOTAL SAVINGS
2009	92			92
2010	94			94
2011	96			96
2012	97			97
2013	98			98
2014	99		0.4	100
2015	101		0.8	102
2016	102	10	1.6	114
2017	103	21	2.1	126
2018	105	21	2.5	128
2019	106	21	2.9	130
2020	107	21	2.9	131
2021	108	22	2.9	133
2022	110	22	2.9	134
2023	111	22	2.9	136
2024	112	22	2.9	138
2025	114	23	2.9	139
2026	115	23	2.9	141
2027	116	23	2.9	142
2028	117	23	2.9	144
2029	119	24	2.9	145
2030	120	24	2.9	147
2031	120	24	2.9	147
2032	120	24	2.9	147
2033	120	24	2.9	147
2034	120	24	2.9	147
2035	120	24	2.9	147
2036	120	24	2.9	147
2037	120	24	2.9	146
2038	120	24	2.9	146
2039	120	24	2.9	146
2040	120	24	2.9	146
2041	120	24	2.9	146
2042	120	24	2.9	146
2043	119	24	2.9	146
2044	119	24	2.9	146
2045	119	24	2.9	146
2046	119	24	2.9	146
2047	119	24	2.9	146
2048	119	24	2.9	146
2049	119	24	2.9	146
2050	119	24	2.9	146
2051	119	24	2.9	146
2052	119	24	2.9	146
2053	119	24	2.9	146
2054	119	24	2.9	146
2055	119	24	2.9	146
2056	119	24	2.9	146
2057	119	24	2.9	146
2058	119	24	2.9	146
2059	119	24	2.9	146
2060	119	24	2.9	146
2061	119	24	2.9	146
2062	119	24	2.9	146
2063	119	24	2.9	146
2064	119	24	2.9	146
2065	119	24	2.9	146
2066	119	24	2.9	146
2067	119	24	2.9	146
2068	119	24	2.9	146
2069	119	24	2.9	146
2070	119	24	2.9	146

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	13.00	0
2015	38,341	11.00	28
2016	38,673	11.00	28
2017	39,005	11.00	28
2018	39,336	11.00	29
2019	39,668	11.00	29
2020	40,000	11.00	29
2021	42,500	11.00	31
2022	45,000	11.00	33
2023	47,500	11.00	35
2024	50,000	11.00	37

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	114	28	142	17	3	4	6	153
2017	126	28	154	17	3	5	7	165
2018	128	29	157	18	3	5	8	166
2019	130	29	159	18	4	6	10	167
2020	131	29	161	18	5	7	11	167
2021	133	31	164	18	5	7	12	170
2022	134	33	167	18	6	7	13	173
2023	136	35	171	19	6	7	13	176
2024	138	37	174	19	7	7	14	179
2025	139	38	177	19	7	7	14	182
2026	141	40	181	19	8	7	15	185
2027	142	42	184	19	8	7	15	188
2028	144	44	188	20	9	7	16	191
2029	145	46	191	20	10	7	16	194
2030	147	47	194	20	10	7	17	197
2031	147	49	196	20	11	6	17	199
2032	147	50	197	20	11	5	17	201
2033	147	52	198	20	12	5	16	202
2034	147	53	200	20	12	4	16	204
2035	147	55	201	20	13	3	16	205
2036	147	56	203	20	13	3	16	207
2037	146	58	204	20	14	2	16	209
2038	146	59	206	20	14	1	15	210
2039	146	61	207	20	15	1	15	212
2040	146	62	208	20	15	0	15	213

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Mabank Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Mabank's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Mabank's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Mabank's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Mabank with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(2)	(2)	2	1	2	(5)
2016	0	(3)	(3)	2	1	3	(5)
2017	0	(3)	(3)	2	1	3	(5)
2018	0	(3)	(3)	2	1	3	(6)
2019	0	(3)	(3)	3	1	4	(7)
2020	0	(3)	(3)	4	1	5	(8)
2021	0	(3)	(3)	4	1	5	(8)
2022	0	(3)	(3)	4	1	5	(8)
2023	0	(3)	(3)	4	1	6	(9)
2024	0	(3)	(3)	5	1	6	(9)
2025	0	(3)	(3)	5	1	6	(9)
2026	0	(3)	(3)	5	1	6	(10)
2027	0	(3)	(3)	5	1	7	(10)
2028	0	(3)	(3)	6	1	7	(10)
2029	0	(3)	(3)	6	1	7	(11)
2030	0	(3)	(3)	6	1	7	(11)
2031	0	(3)	(3)	7	1	8	(11)
2032	0	(3)	(3)	7	1	8	(11)
2033	0	(4)	(4)	7	1	8	(12)
2034	0	(4)	(4)	8	1	8	(12)
2035	0	(4)	(4)	8	1	9	(12)
2036	0	(4)	(4)	8	1	9	(13)
2037	0	(4)	(4)	9	0	9	(13)
2038	0	(4)	(4)	9	0	9	(13)
2039	0	(4)	(4)	9	0	10	(13)
2040	0	(4)	(4)	10	0	10	(14)
2041	0	(4)	(4)	10	0	10	(14)
2042	0	(4)	(4)	11	0	11	(15)
2043	0	(4)	(4)	11	0	11	(16)
2044	0	(4)	(4)	12	0	12	(16)
2045	0	(5)	(5)	13	0	13	(17)
2046	0	(5)	(5)	13	0	13	(18)
2047	0	(5)	(5)	14	0	14	(19)
2048	0	(5)	(5)	14	0	14	(19)
2049	0	(5)	(5)	15	0	15	(20)
2050	0	(5)	(5)	15	0	15	(21)
2051	0	(6)	(6)	16	0	16	(22)
2052	0	(6)	(6)	17	0	17	(23)
2053	0	(6)	(6)	18	0	18	(24)
2054	0	(6)	(6)	19	0	19	(26)
2055	0	(7)	(7)	20	0	20	(27)
2056	0	(7)	(7)	21	0	21	(28)
2057	0	(7)	(7)	22	0	22	(29)
2058	0	(8)	(8)	23	0	23	(31)
2059	0	(8)	(8)	24	0	24	(32)
2060	0	(8)	(8)	25	0	25	(33)
2061	0	(8)	(8)	27	0	27	(35)
2062	0	(9)	(9)	28	0	28	(37)
2063	0	(9)	(9)	29	0	29	(39)
2064	0	(9)	(9)	31	0	31	(40)
2065	0	(10)	(10)	32	0	32	(42)
2066	0	(10)	(10)	34	0	34	(44)
2067	0	(11)	(11)	35	0	35	(46)
2068	0	(11)	(11)	37	0	37	(48)
2069	0	(11)	(11)	38	0	38	(50)
2070	0	(12)	(12)	40	0	40	(51)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Mabank's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	74	0	0	0
1	2015	3,351	74	(0)	(2)	(2)
2	2016	3,471	74	(1)	(3)	(2)
3	2017	3,591	75	(1)	(3)	(2)
4	2018	3,710	75	(1)	(3)	(2)
5-year Goal	2019	3,830	75	(1)	(3)	(1)
6	2020	3,950	74	0	(3)	(3)
7	2021	4,015	73	1	(3)	(4)
8	2022	4,080	72	3	(3)	(6)
9	2023	4,145	71	5	(3)	(8)
10-year Goal	2024	4,210	70	6	(3)	(9)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Mabank's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	7.00	0	0	0
1	2015	3,351	7.00	0	(2)	(2)
2	2016	3,471	7.00	0	(3)	(3)
3	2017	3,591	7.00	0	(3)	(3)
4	2018	3,710	7.00	0	(3)	(3)
5-year Goal	2019	3,830	7.00	0	(3)	(3)
6	2020	3,950	6.40	1	(3)	(4)
7	2021	4,015	5.80	2	(3)	(5)
8	2022	4,080	5.20	3	(3)	(6)
9	2023	4,145	4.60	4	(3)	(7)
10-year Goal	2024	4,210	4.00	5	(3)	(8)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	11.00	0
2015	3,351	13.00	(2)
2016	3,471	13.00	(3)
2017	3,591	13.00	(3)
2018	3,710	13.00	(3)
2019	3,830	13.00	(3)
2020	3,950	13.00	(3)
2021	4,015	13.00	(3)
2022	4,080	13.00	(3)
2023	4,145	13.00	(3)
2024	4,210	13.00	(3)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 19 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(3)	(3)	19	2	1	3	14
2017	0	(3)	(3)	20	2	1	3	14
2018	0	(3)	(3)	20	2	1	3	14
2019	0	(3)	(3)	20	3	1	4	13
2020	0	(3)	(3)	20	4	1	5	13
2021	0	(3)	(3)	21	4	1	5	13
2022	0	(3)	(3)	21	4	1	5	13
2023	0	(3)	(3)	21	4	1	6	13
2024	0	(3)	(3)	22	5	1	6	13
2025	0	(3)	(3)	22	5	1	6	13
2026	0	(3)	(3)	22	5	1	6	13
2027	0	(3)	(3)	22	5	1	7	13
2028	0	(3)	(3)	23	6	1	7	13
2029	0	(3)	(3)	23	6	1	7	13
2030	0	(3)	(3)	23	6	1	7	13
2031	0	(3)	(3)	24	7	1	8	13
2032	0	(3)	(3)	24	7	1	8	13
2033	0	(4)	(4)	24	7	1	8	13
2034	0	(4)	(4)	25	8	1	8	13
2035	0	(4)	(4)	25	8	1	9	13
2036	0	(4)	(4)	25	8	1	9	13
2037	0	(4)	(4)	25	9	0	9	13
2038	0	(4)	(4)	26	9	0	9	13
2039	0	(4)	(4)	26	9	0	10	13
2040	0	(4)	(4)	26	10	0	10	13

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(3)	(3)	3	2	1	3	(2)
2017	0	(3)	(3)	3	2	1	3	(2)
2018	0	(3)	(3)	3	2	1	3	(3)
2019	0	(3)	(3)	3	3	1	4	(3)
2020	0	(3)	(3)	3	4	1	5	(4)
2021	0	(3)	(3)	3	4	1	5	(5)
2022	0	(3)	(3)	4	4	1	5	(5)
2023	0	(3)	(3)	4	4	1	6	(5)
2024	0	(3)	(3)	4	5	1	6	(5)
2025	0	(3)	(3)	4	5	1	6	(6)
2026	0	(3)	(3)	4	5	1	6	(6)
2027	0	(3)	(3)	4	5	1	7	(6)
2028	0	(3)	(3)	4	6	1	7	(6)
2029	0	(3)	(3)	4	6	1	7	(7)
2030	0	(3)	(3)	4	6	1	7	(7)
2031	0	(3)	(3)	4	7	1	8	(7)
2032	0	(3)	(3)	4	7	1	8	(7)
2033	0	(4)	(4)	4	7	1	8	(8)
2034	0	(4)	(4)	4	8	1	8	(8)
2035	0	(4)	(4)	4	8	1	9	(8)
2036	0	(4)	(4)	4	8	1	9	(8)
2037	0	(4)	(4)	4	9	0	9	(9)
2038	0	(4)	(4)	4	9	0	9	(9)
2039	0	(4)	(4)	4	9	0	10	(9)
2040	0	(4)	(4)	4	10	0	10	(9)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 5 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(3)	(3)	5	2	1	3	(0)
2017	0	(3)	(3)	5	2	1	3	(1)
2018	0	(3)	(3)	5	2	1	3	(1)
2019	0	(3)	(3)	5	3	1	4	(2)
2020	0	(3)	(3)	5	4	1	5	(3)
2021	0	(3)	(3)	5	4	1	5	(3)
2022	0	(3)	(3)	5	4	1	5	(3)
2023	0	(3)	(3)	5	4	1	6	(3)
2024	0	(3)	(3)	5	5	1	6	(4)
2025	0	(3)	(3)	5	5	1	6	(4)
2026	0	(3)	(3)	6	5	1	6	(4)
2027	0	(3)	(3)	6	5	1	7	(4)
2028	0	(3)	(3)	6	6	1	7	(5)
2029	0	(3)	(3)	6	6	1	7	(5)
2030	0	(3)	(3)	6	6	1	7	(5)
2031	0	(3)	(3)	6	7	1	8	(5)
2032	0	(3)	(3)	6	7	1	8	(5)
2033	0	(4)	(4)	6	7	1	8	(6)
2034	0	(4)	(4)	6	8	1	8	(6)
2035	0	(4)	(4)	6	8	1	9	(6)
2036	0	(4)	(4)	6	8	1	9	(6)
2037	0	(4)	(4)	6	9	0	9	(6)
2038	0	(4)	(4)	6	9	0	9	(7)
2039	0	(4)	(4)	7	9	0	10	(7)
2040	0	(4)	(4)	7	10	0	10	(7)

4. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of McKinney Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares McKinney's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) McKinney's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in McKinney's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for McKinney with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,197	(1,123)	75	68	41	110	(35)
2016	1,316	(1,135)	181	85	51	137	44
2017	1,343	(1,148)	195	85	62	147	48
2018	1,370	(1,160)	210	103	72	175	35
2019	1,396	(1,172)	224	120	82	202	22
2020	1,423	(1,185)	238	154	93	246	(8)
2021	1,449	(1,197)	252	168	102	270	(17)
2022	1,476	(1,209)	266	182	111	293	(27)
2023	1,502	(1,222)	281	196	121	316	(36)
2024	1,529	(1,234)	295	209	130	340	(45)
2025	1,555	(1,246)	309	223	139	363	(54)
2026	1,582	(1,259)	323	237	149	386	(63)
2027	1,608	(1,271)	337	251	158	409	(72)
2028	1,635	(1,283)	352	265	168	433	(81)
2029	1,662	(1,296)	367	279	177	456	(90)
2030	1,689	(1,308)	381	293	186	479	(98)
2031	1,765	(1,368)	397	322	187	509	(112)
2032	1,840	(1,427)	413	351	187	538	(125)
2033	1,915	(1,487)	428	380	187	567	(138)
2034	1,991	(1,547)	444	409	187	596	(152)
2035	2,066	(1,606)	460	438	187	625	(165)
2036	2,141	(1,666)	476	466	188	654	(178)
2037	2,217	(1,725)	491	495	188	683	(192)
2038	2,292	(1,785)	507	524	188	712	(205)
2039	2,367	(1,845)	523	553	188	741	(218)
2040	2,443	(1,904)	539	582	188	770	(232)
2041	2,516	(1,962)	554	608	194	802	(248)
2042	2,590	(2,020)	570	633	200	833	(263)
2043	2,663	(2,078)	585	659	205	865	(279)
2044	2,737	(2,136)	601	685	211	896	(295)
2045	2,810	(2,193)	617	711	217	927	(311)
2046	2,883	(2,251)	632	736	222	959	(327)
2047	2,957	(2,309)	648	762	228	990	(342)
2048	3,030	(2,367)	663	788	234	1,022	(358)
2049	3,104	(2,425)	679	813	239	1,053	(374)
2050	3,177	(2,483)	695	839	245	1,084	(390)
2051	3,177	(2,483)	694	847	245	1,093	(398)
2052	3,177	(2,483)	694	856	245	1,101	(407)
2053	3,176	(2,483)	694	864	245	1,109	(415)
2054	3,176	(2,483)	693	872	245	1,117	(424)
2055	3,176	(2,483)	693	881	245	1,125	(432)
2056	3,176	(2,483)	693	889	245	1,134	(441)
2057	3,175	(2,483)	693	897	245	1,142	(449)
2058	3,175	(2,483)	692	905	245	1,150	(458)
2059	3,175	(2,483)	692	914	245	1,158	(466)
2060	3,174	(2,483)	692	922	245	1,167	(475)
2061	3,174	(2,483)	692	930	245	1,175	(483)
2062	3,174	(2,483)	692	939	245	1,183	(492)
2063	3,174	(2,483)	692	947	245	1,192	(500)
2064	3,174	(2,483)	692	955	245	1,200	(508)
2065	3,174	(2,483)	692	964	245	1,208	(517)
2066	3,174	(2,483)	692	972	245	1,217	(525)
2067	3,174	(2,483)	692	980	245	1,225	(534)
2068	3,174	(2,483)	692	989	245	1,233	(542)
2069	3,174	(2,483)	692	997	245	1,242	(550)
2070	3,174	(2,483)	692	1,005	245	1,250	(559)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how McKinney's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	185	0	0	0
1	2015	161,905	184	59	75	16
2	2016	163,687	183	119	181	61
3	2017	165,468	182	181	195	14
4	2018	167,250	181	244	210	(34)
5-year Goal	2019	169,031	180	308	224	(84)
6	2020	170,813	179	374	238	(136)
7	2021	172,595	178	441	252	(189)
8	2022	174,376	177	509	266	(243)
9	2023	176,158	176	579	281	(298)
10-year Goal	2024	177,939	175	649	295	(355)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how McKinney's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	25.00	0	0	0
1	2015	161,905	24.00	59	(1,123)	(1,182)
2	2016	163,687	23.00	119	(1,135)	(1,255)
3	2017	165,468	22.00	181	(1,148)	(1,329)
4	2018	167,250	21.00	244	(1,160)	(1,404)
5-year Goal	2019	169,031	20.00	308	(1,172)	(1,481)
6	2020	170,813	19.80	324	(1,185)	(1,509)
7	2021	172,595	19.60	340	(1,197)	(1,537)
8	2022	174,376	19.40	356	(1,209)	(1,566)
9	2023	176,158	19.20	373	(1,222)	(1,595)
10-year Goal	2024	177,939	19.00	390	(1,234)	(1,624)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 1,123 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 11.0% increase in 2015
        ii. 4.0% increase in 2016
    b. Estimated customer demand reduction of 3.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
   a. Estimated savings of 9.68% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
      i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	2x Watering Ordinance	Irrigation (ET) Controller Rebates	TOTAL SAVINGS
2009			0.5	0
2010			0.9	1
2011			1.4	1
2012			1.8	2
2013			2.3	2
2014		961	2.7	964
2015	213	981	3.2	1,197
2016	311	1,002	3.6	1,316
2017	317	1,022	3.6	1,343
2018	323	1,043	3.6	1,370
2019	330	1,064	3.2	1,396
2020	336	1,084	2.7	1,423
2021	342	1,105	2.3	1,449
2022	349	1,125	1.8	1,476
2023	355	1,146	1.4	1,502
2024	361	1,166	0.9	1,529
2025	368	1,187	0.5	1,555
2026	374	1,207		1,582
2027	381	1,228		1,608
2028	387	1,248		1,635
2029	393	1,269		1,662
2030	400	1,290		1,689
2031	417	1,347		1,765
2032	435	1,405		1,840
2033	453	1,462		1,915
2034	471	1,520		1,991
2035	489	1,577		2,066
2036	507	1,635		2,141
2037	524	1,692		2,217
2038	542	1,750		2,292
2039	560	1,807		2,367
2040	578	1,865		2,443
2041	595	1,921		2,516
2042	613	1,977		2,590
2043	630	2,033		2,663
2044	647	2,089		2,737
2045	665	2,145		2,810
2046	682	2,201		2,883
2047	700	2,257		2,957
2048	717	2,313		3,030
2049	734	2,369		3,104
2050	752	2,426		3,177
2051	752	2,425		3,177
2052	752	2,425		3,177
2053	752	2,425		3,176
2054	751	2,425		3,176
2055	751	2,424		3,176
2056	751	2,424		3,176
2057	751	2,424		3,175
2058	751	2,424		3,175
2059	751	2,424		3,175
2060	751	2,423		3,174
2061	751	2,423		3,174
2062	751	2,423		3,174
2063	751	2,423		3,174
2064	751	2,423		3,174
2065	751	2,423		3,174
2066	751	2,423		3,174
2067	751	2,423		3,174
2068	751	2,423		3,174
2069	751	2,423		3,174
2070	751	2,423		3,174

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	25.00	0
2015	161,905	44.00	(1,123)
2016	163,687	44.00	(1,135)
2017	165,468	44.00	(1,148)
2018	167,250	44.00	(1,160)
2019	169,031	44.00	(1,172)
2020	170,813	44.00	(1,185)
2021	172,595	44.00	(1,197)
2022	174,376	44.00	(1,209)
2023	176,158	44.00	(1,222)
2024	177,939	44.00	(1,234)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,316	(1,135)	181	139	85	51	137	183
2017	1,343	(1,148)	195	142	85	62	147	190
2018	1,370	(1,160)	210	144	103	72	175	180
2019	1,396	(1,172)	224	147	120	82	202	169
2020	1,423	(1,185)	238	150	154	93	246	142
2021	1,449	(1,197)	252	153	168	102	270	136
2022	1,476	(1,209)	266	156	182	111	293	129
2023	1,502	(1,222)	281	159	196	121	316	123
2024	1,529	(1,234)	295	161	209	130	340	117
2025	1,555	(1,246)	309	164	223	139	363	110
2026	1,582	(1,259)	323	167	237	149	386	104
2027	1,608	(1,271)	337	170	251	158	409	98
2028	1,635	(1,283)	352	173	265	168	433	92
2029	1,662	(1,296)	367	176	279	177	456	86
2030	1,689	(1,308)	381	179	293	186	479	80
2031	1,765	(1,368)	397	186	322	187	509	75
2032	1,840	(1,427)	413	194	351	187	538	69
2033	1,915	(1,487)	428	202	380	187	567	64
2034	1,991	(1,547)	444	210	409	187	596	59
2035	2,066	(1,606)	460	218	438	187	625	53
2036	2,141	(1,666)	476	226	466	188	654	48
2037	2,217	(1,725)	491	234	495	188	683	43
2038	2,292	(1,785)	507	242	524	188	712	37
2039	2,367	(1,845)	523	250	553	188	741	32
2040	2,443	(1,904)	539	258	582	188	770	26

2. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Mesquite Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Mesquite's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Mesquite's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Mesquite's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8][9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Mesquite with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	605	420	1,025	11	16	27	998
2016	723	423	1,146	13	20	34	1,112
2017	728	426	1,154	13	24	38	1,116
2018	733	429	1,162	16	28	44	1,118
2019	738	432	1,170	19	32	51	1,119
2020	743	435	1,178	24	37	61	1,117
2021	748	440	1,187	27	37	63	1,124
2022	753	444	1,197	30	37	66	1,131
2023	758	448	1,206	32	37	69	1,137
2024	763	453	1,215	35	37	72	1,144
2025	768	457	1,225	38	37	74	1,150
2026	773	461	1,234	41	37	77	1,157
2027	778	466	1,243	44	37	80	1,163
2028	783	470	1,253	46	37	83	1,170
2029	788	474	1,262	49	37	86	1,177
2030	793	479	1,272	52	37	88	1,183
2031	801	485	1,286	55	33	88	1,198
2032	809	491	1,300	59	29	88	1,213
2033	818	497	1,315	62	26	88	1,227
2034	826	504	1,329	66	22	87	1,242
2035	834	510	1,344	69	18	87	1,257
2036	842	516	1,358	72	15	87	1,271
2037	851	522	1,373	76	11	87	1,286
2038	859	528	1,387	79	7	86	1,301
2039	867	535	1,402	83	4	86	1,315
2040	875	541	1,416	86	0	86	1,330
2041	882	546	1,428	90	0	90	1,338
2042	889	550	1,440	93	0	93	1,346
2043	896	555	1,451	97	0	97	1,354
2044	903	560	1,463	101	0	101	1,362
2045	910	565	1,475	105	0	105	1,370
2046	917	570	1,487	108	0	108	1,378
2047	923	575	1,498	112	0	112	1,386
2048	930	580	1,510	116	0	116	1,394
2049	937	585	1,522	119	0	119	1,403
2050	944	590	1,534	123	0	123	1,411
2051	951	594	1,546	127	0	127	1,418
2052	959	599	1,558	132	0	132	1,426
2053	966	604	1,570	136	0	136	1,434
2054	973	609	1,582	140	0	140	1,442
2055	981	613	1,594	145	0	145	1,450
2056	988	618	1,606	149	0	149	1,457
2057	996	623	1,618	153	0	153	1,465
2058	1,003	628	1,630	157	0	157	1,473
2059	1,010	632	1,643	162	0	162	1,481
2060	1,018	637	1,655	166	0	166	1,489
2061	1,025	642	1,667	171	0	171	1,496
2062	1,033	647	1,679	176	0	176	1,504
2063	1,040	651	1,692	181	0	181	1,511
2064	1,048	656	1,704	186	0	186	1,518
2065	1,055	661	1,716	190	0	190	1,526
2066	1,063	666	1,729	195	0	195	1,533
2067	1,070	671	1,741	200	0	200	1,541
2068	1,078	675	1,753	205	0	205	1,548
2069	1,085	680	1,765	210	0	210	1,556
2070	1,093	685	1,778	215	0	215	1,563

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Mesquite's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	166	0	0	0
1	2015	144,788	161	264	1,025	761
2	2016	145,830	156	532	1,146	614
3	2017	146,873	151	804	1,154	350
4	2018	147,915	146	1,080	1,162	82
5-year Goal	2019	148,958	141	1,359	1,170	(189)
6	2020	150,000	139	1,467	1,178	(289)
7	2021	151,500	137	1,582	1,187	(394)
8	2022	153,000	136	1,698	1,197	(501)
9	2023	154,500	134	1,816	1,206	(610)
10-year Goal	2024	156,000	132	1,936	1,215	(721)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Mesquite's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	15.95	0	0	0
1	2015	144,788	16.16	(11)	420	431
2	2016	145,830	16.37	(22)	423	446
3	2017	146,873	16.58	(34)	426	460
4	2018	147,915	16.79	(45)	429	475
5-year Goal	2019	148,958	17.00	(57)	432	489
6	2020	150,000	16.80	(47)	435	482
7	2021	151,500	16.60	(36)	440	476
8	2022	153,000	16.40	(25)	444	469
9	2023	154,500	16.20	(14)	448	462
10-year Goal	2024	156,000	16.00	(3)	453	456

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 420 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10% increase in 2015
        ii. 8% increase in 2016
    b. Estimated customer demand reduction of 3.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 6.53% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

6. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

a. Project initiated in service area in 2015
b. Save Water completed work on 280 multi-family units in 2015
c. Average monthly savings of 427,074 gallons
d. Annualized savings of 5.12 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	2x Watering Ordinance	Save Water Co. Program	TOTAL SAVINGS
2009				0
2010				0
2011				0
2012				0
2013				0
2014				0
2015	141	459	5.1	605.2
2016	255	463	5.1	722.8
2017	257	466	5.1	727.8
2018	259	469	5.1	732.8
2019	260	472	5.1	737.8
2020	262	476	5.1	742.8
2021	264	479	5.1	747.8
2022	266	482	5.1	752.8
2023	267	485	5.1	757.8
2024	269	488	5.1	762.8
2025	271	492	5.1	767.8
2026	273	495	5.1	772.8
2027	275	498	5.1	777.8
2028	276	501	5.1	782.8
2029	278	505	5.1	787.8
2030	280	508	5.1	792.8
2031	283	513	5.1	801.0
2032	286	518	5.1	809.3
2033	289	524	5.1	817.6
2034	292	529	5.1	825.8
2035	295	534	5.1	834.1
2036	298	540	5.1	842.3
2037	300	545	5.1	850.6
2038	303	550	5.1	858.9
2039	306	556	5.1	867.1
2040	309	561	5.1	875.4
2041	312	565	5.1	882.3
2042	314	570	5.1	889.1
2043	317	574	5.1	896.0
2044	319	579	5.1	902.9
2045	321	583	5.1	909.7
2046	324	588	5.1	916.6
2047	326	592	5.1	923.5
2048	329	596	5.1	930.3
2049	331	601	5.1	937.2
2050	334	605	5.1	944.1
2051	336	610	5.1	951.4
2052	339	615	5.1	958.8
2053	342	619	5.1	966.1
2054	344	624	5.1	973.5
2055	347	629	5.1	980.8
2056	349	634	5.1	988.2
2057	352	638	5.1	995.5
2058	355	643	5.1	1,002.9
2059	357	648	5.1	1,010.2
2060	360	653	5.1	1,017.6
2061	362	657	5.1	1,025.1
2062	365	662	5.1	1,032.6
2063	368	667	5.1	1,040.1
2064	370	672	5.1	1,047.7
2065	373	677	5.1	1,055.2
2066	376	682	5.1	1,062.7
2067	379	687	5.1	1,070.2
2068	381	691	5.1	1,077.8
2069	384	696	5.1	1,085.3
2070	387	701	5.1	1,092.8

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.95	0
2015	144,788	8.00	420
2016	145,830	8.00	423
2017	146,873	8.00	426
2018	147,915	8.00	429
2019	148,958	8.00	432
2020	150,000	8.00	435
2021	151,500	8.00	440
2022	153,000	8.00	444
2023	154,500	8.00	448
2024	156,000	8.00	453

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	723	423	1,146	95	13	20	34	1,207
2017	728	426	1,154	96	13	24	38	1,212
2018	733	429	1,162	96	16	28	44	1,214
2019	738	432	1,170	97	19	32	51	1,216
2020	743	435	1,178	98	24	37	61	1,215
2021	748	440	1,187	98	27	37	63	1,222
2022	753	444	1,197	99	30	37	66	1,229
2023	758	448	1,206	100	32	37	69	1,237
2024	763	453	1,215	100	35	37	72	1,244
2025	768	457	1,225	101	38	37	74	1,251
2026	773	461	1,234	102	41	37	77	1,258
2027	778	466	1,243	102	44	37	80	1,266
2028	783	470	1,253	103	46	37	83	1,273
2029	788	474	1,262	104	49	37	86	1,280
2030	793	479	1,272	104	52	37	88	1,287
2031	801	485	1,286	105	55	33	88	1,303
2032	809	491	1,300	106	59	29	88	1,319
2033	818	497	1,315	107	62	26	88	1,335
2034	826	504	1,329	109	66	22	87	1,351
2035	834	510	1,344	110	69	18	87	1,366
2036	842	516	1,358	111	72	15	87	1,382
2037	851	522	1,373	112	76	11	87	1,398
2038	859	528	1,387	113	79	7	86	1,414
2039	867	535	1,402	114	83	4	86	1,429
2040	875	541	1,416	115	86	0	86	1,445

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Midlothian Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Midlothian's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Midlothian's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Midlothian's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Midlothian with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	8	23	31	11	3	14	17
2016	24	23	47	14	4	17	30
2017	25	24	49	14	5	18	30
2018	26	24	50	16	5	22	28
2019	27	24	51	19	6	25	25
2020	27	24	52	24	7	31	20
2021	28	25	53	28	7	35	18
2022	29	25	54	31	7	38	16
2023	30	25	55	34	7	41	14
2024	31	25	56	37	7	44	12
2025	31	25	57	40	7	47	10
2026	32	25	57	43	7	50	8
2027	33	25	58	46	7	53	5
2028	34	26	59	49	7	56	3
2029	35	26	60	52	7	59	1
2030	35	26	61	55	7	62	(1)
2031	36	27	63	59	6	65	(2)
2032	38	28	65	63	5	68	(3)
2033	39	28	67	67	5	72	(5)
2034	40	29	69	71	4	75	(6)
2035	41	30	71	74	3	78	(7)
2036	42	31	73	78	3	81	(8)
2037	43	32	74	82	2	84	(10)
2038	44	32	76	86	1	87	(11)
2039	45	33	78	89	1	90	(12)
2040	46	34	80	93	0	93	(13)
2041	47	35	82	96	0	96	(14)
2042	48	35	84	99	0	99	(16)
2043	49	36	85	102	0	102	(17)
2044	50	37	87	105	0	105	(18)
2045	51	38	89	108	0	108	(20)
2046	52	38	90	111	0	111	(21)
2047	53	39	92	114	0	114	(22)
2048	54	40	94	117	0	117	(24)
2049	55	41	96	120	0	120	(25)
2050	56	41	97	124	0	124	(26)
2051	57	42	99	127	0	127	(28)
2052	58	43	100	130	0	130	(29)
2053	59	43	102	133	0	133	(31)
2054	60	44	104	136	0	136	(32)
2055	60	45	105	139	0	139	(34)
2056	61	45	107	142	0	142	(35)
2057	62	46	108	145	0	145	(37)
2058	63	47	110	148	0	148	(38)
2059	64	47	111	151	0	151	(40)
2060	65	48	113	154	0	154	(41)
2061	66	49	114	157	0	157	(43)
2062	66	49	115	160	0	160	(45)
2063	67	50	116	163	0	163	(46)
2064	68	50	118	165	0	165	(48)
2065	68	51	119	168	0	168	(49)
2066	69	51	120	171	0	171	(51)
2067	70	52	121	174	0	174	(53)
2068	70	52	122	177	0	177	(54)
2069	71	53	124	180	0	180	(56)
2070	72	53	125	183	0	183	(58)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Midlothian's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	169	0	0	0
1	2015	21,009	168	8	31	24
2	2016	21,271	167	16	47	32
3	2017	21,533	166	24	49	25
4	2018	21,794	165	32	50	18
5-year Goal	2019	22,056	164	40	51	10
6	2020	22,318	163	49	52	3
7	2021	22,451	162	57	53	(5)
8	2022	22,583	161	66	54	(12)
9	2023	22,716	160	75	55	(20)
10-year Goal	2024	22,848	159	83	56	(28)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Midlothian's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	21,009	16.00	0	23	23
2	2016	21,271	16.00	0	23	23
3	2017	21,533	16.00	0	24	24
4	2018	21,794	16.00	0	24	24
5-year Goal	2019	22,056	16.00	0	24	24
6	2020	22,318	16.00	0	24	24
7	2021	22,451	16.00	0	25	25
8	2022	22,583	16.00	0	25	25
9	2023	22,716	16.00	0	25	25
10-year Goal	2024	22,848	16.00	0	25	25

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 23 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3.5% increase in 2016
        ii. 6.5% increase in 2016
    b. Estimated customer demand reduction of 2.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	8	8
2016	24	24
2017	25	25
2018	26	26
2019	27	27
2020	27	27
2021	28	28
2022	29	29
2023	30	30
2024	31	31
2025	31	31
2026	32	32
2027	33	33
2028	34	34
2029	35	35
2030	35	35
2031	36	36
2032	38	38
2033	39	39
2034	40	40
2035	41	41
2036	42	42
2037	43	43
2038	44	44
2039	45	45
2040	46	46
2041	47	47
2042	48	48
2043	49	49
2044	50	50
2045	51	51
2046	52	52
2047	53	53
2048	54	54
2049	55	55
2050	56	56
2051	57	57
2052	58	58
2053	59	59
2054	60	60
2055	60	60
2056	61	61
2057	62	62
2058	63	63
2059	64	64
2060	65	65
2061	66	66
2062	66	66
2063	67	67
2064	68	68
2065	68	68
2066	69	69
2067	70	70
2068	70	70
2069	71	71
2070	72	72

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	21,009	13.00	23
2016	21,271	13.00	23
2017	21,533	13.00	24
2018	21,794	13.00	24
2019	22,056	13.00	24
2020	22,318	13.00	24
2021	22,451	13.00	25
2022	22,583	13.00	25
2023	22,716	13.00	25
2024	22,848	13.00	25

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 97 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	24	23	47	97	14	4	17	127
2017	25	24	49	100	14	5	18	130
2018	26	24	50	103	16	5	22	131
2019	27	24	51	106	19	6	25	132
2020	27	24	52	109	24	7	31	130
2021	28	25	53	113	28	7	35	131
2022	29	25	54	116	31	7	38	132
2023	30	25	55	119	34	7	41	133
2024	31	25	56	122	37	7	44	134
2025	31	25	57	125	40	7	47	135
2026	32	25	57	129	43	7	50	136
2027	33	25	58	132	46	7	53	137
2028	34	26	59	135	49	7	56	138
2029	35	26	60	138	52	7	59	139
2030	35	26	61	142	55	7	62	141
2031	36	27	63	146	59	6	65	144
2032	38	28	65	150	63	5	68	147
2033	39	28	67	154	67	5	72	150
2034	40	29	69	159	71	4	75	153
2035	41	30	71	163	74	3	78	156
2036	42	31	73	167	78	3	81	159
2037	43	32	74	171	82	2	84	162
2038	44	32	76	176	86	1	87	165
2039	45	33	78	180	89	1	90	168
2040	46	34	80	184	93	0	93	171

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	24	23	47	16	14	4	17	46
2017	25	24	49	17	14	5	18	47
2018	26	24	50	17	16	5	22	45
2019	27	24	51	18	19	6	25	43
2020	27	24	52	18	24	7	31	39
2021	28	25	53	19	28	7	35	37
2022	29	25	54	19	31	7	38	36
2023	30	25	55	20	34	7	41	34
2024	31	25	56	20	37	7	44	32
2025	31	25	57	21	40	7	47	31
2026	32	25	57	22	43	7	50	29
2027	33	25	58	22	46	7	53	28
2028	34	26	59	23	49	7	56	26
2029	35	26	60	23	52	7	59	24
2030	35	26	61	24	55	7	62	23
2031	36	27	63	24	59	6	65	22
2032	38	28	65	25	63	5	68	22
2033	39	28	67	26	67	5	72	21
2034	40	29	69	27	71	4	75	21
2035	41	30	71	27	74	3	78	20
2036	42	31	73	28	78	3	81	20
2037	43	32	74	29	82	2	84	19
2038	44	32	76	29	86	1	87	19
2039	45	33	78	30	89	1	90	18
2040	46	34	80	31	93	0	93	18

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Mountain Peak SUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Mountain Peak SUD's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Mountain Peak SUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Mountain Peak SUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Mountain Peak SUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	21	5	26	1	1	2	24
2016	21	5	26	1	1	3	24
2017	22	5	27	1	2	3	24
2018	23	5	28	1	2	3	24
2019	23	5	28	2	2	4	24
2020	24	5	29	2	3	5	24
2021	24	5	30	2	3	5	25
2022	25	5	30	2	3	5	26
2023	26	6	31	3	3	5	26
2024	26	6	32	3	3	5	27
2025	27	6	33	3	3	6	27
2026	27	6	33	3	3	6	28
2027	28	6	34	3	3	6	28
2028	29	6	35	4	3	6	29
2029	29	6	36	4	3	6	29
2030	30	7	36	4	3	7	30
2031	30	7	37	4	2	7	30
2032	31	7	38	5	2	7	31
2033	32	7	39	5	2	7	32
2034	32	7	40	6	2	7	32
2035	33	7	40	6	1	8	33
2036	34	7	41	7	1	8	33
2037	34	8	42	7	1	8	34
2038	35	8	43	8	1	8	35
2039	36	8	44	8	0	8	35
2040	36	8	44	8	0	8	36
2041	37	8	45	10	4	14	32
2042	38	8	46	12	8	19	27
2043	39	8	47	13	11	25	23
2044	40	9	48	15	15	30	18
2045	40	9	49	16	19	35	14
2046	41	9	50	18	23	41	9
2047	42	9	51	20	26	46	5
2048	43	9	52	21	30	51	0
2049	44	9	53	23	34	57	(4)
2050	44	9	54	24	38	62	(8)
2051	45	10	55	26	48	74	(19)
2052	46	10	56	28	58	86	(30)
2053	47	10	57	29	68	97	(40)
2054	48	10	58	31	78	109	(51)
2055	49	10	59	33	88	121	(62)
2056	50	10	60	34	98	133	(72)
2057	51	10	61	36	108	144	(83)
2058	52	11	62	38	118	156	(94)
2059	53	11	63	39	128	168	(104)
2060	54	11	64	41	139	180	(115)
2061	55	11	66	43	141	185	(119)
2062	56	11	67	45	144	190	(123)
2063	57	11	68	48	147	195	(127)
2064	58	11	69	50	150	200	(131)
2065	59	12	70	52	153	205	(135)
2066	60	12	72	54	156	210	(139)
2067	61	12	73	56	159	215	(143)
2068	62	12	74	58	162	221	(146)
2069	63	12	75	60	165	226	(150)
2070	64	12	76	63	168	231	(154)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Mountain Peak SUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	131	0	0	0
1	2015	12,765	129	6	26	19
2	2016	13,063	128	13	26	13
3	2017	13,361	127	20	27	7
4	2018	13,659	125	27	28	1
5-year Goal	2019	13,957	124	34	28	(6)
6	2020	14,255	123	42	29	(13)
7	2021	14,637	121	51	30	(21)
8	2022	15,020	120	60	30	(29)
9	2023	15,402	118	69	31	(38)
10-year Goal	2024	15,785	117	79	32	(47)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Mountain Peak SUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	38.00	0	0	0
1	2015	12,765	37.00	5	5	0
2	2016	13,063	36.00	10	5	(5)
3	2017	13,361	35.00	15	5	(10)
4	2018	13,659	34.00	20	5	(15)
5-year Goal	2019	13,957	33.00	25	5	(20)
6	2020	14,255	32.00	31	5	(26)
7	2021	14,637	31.00	37	5	(32)
8	2022	15,020	30.00	44	5	(38)
9	2023	15,402	29.00	51	6	(45)
10-year Goal	2024	15,785	28.00	58	6	(52)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 5 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 16.4% increase in 2015
    b. Estimated customer demand reduction of 3.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	21	21
2016	21	21
2017	22	22
2018	23	23
2019	23	23
2020	24	24
2021	24	24
2022	25	25
2023	26	26
2024	26	26
2025	27	27
2026	27	27
2027	28	28
2028	29	29
2029	29	29
2030	30	30
2031	30	30
2032	31	31
2033	32	32
2034	32	32
2035	33	33
2036	34	34
2037	34	34
2038	35	35
2039	36	36
2040	36	36
2041	37	37
2042	38	38
2043	39	39
2044	40	40
2045	40	40
2046	41	41
2047	42	42
2048	43	43
2049	44	44
2050	44	44
2051	45	45
2052	46	46
2053	47	47
2054	48	48
2055	49	49
2056	50	50
2057	51	51
2058	52	52
2059	53	53
2060	54	54
2061	55	55
2062	56	56
2063	57	57
2064	58	58
2065	59	59
2066	60	60
2067	61	61
2068	62	62
2069	63	63
2070	64	64

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	38.00	0
2015	12,765	37.00	5
2016	13,063	37.00	5
2017	13,361	37.00	5
2018	13,659	37.00	5
2019	13,957	37.00	5
2020	14,255	37.00	5
2021	14,637	37.00	5
2022	15,020	37.00	5
2023	15,402	37.00	6
2024	15,785	37.00	6

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 54 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	21	5	26	54	1	1	3	77
2017	22	5	27	55	1	2	3	79
2018	23	5	28	57	1	2	3	81
2019	23	5	28	58	2	2	4	83
2020	24	5	29	60	2	3	5	84
2021	24	5	30	61	2	3	5	86
2022	25	5	30	62	2	3	5	88
2023	26	6	31	64	3	3	5	90
2024	26	6	32	65	3	3	5	92
2025	27	6	33	67	3	3	6	94
2026	27	6	33	68	3	3	6	96
2027	28	6	34	70	3	3	6	98
2028	29	6	35	71	4	3	6	100
2029	29	6	36	73	4	3	6	102
2030	30	7	36	74	4	3	7	104
2031	30	7	37	76	4	2	7	106
2032	31	7	38	78	5	2	7	109
2033	32	7	39	79	5	2	7	111
2034	32	7	40	81	6	2	7	113
2035	33	7	40	83	6	1	8	115
2036	34	7	41	84	7	1	8	118
2037	34	8	42	86	7	1	8	120
2038	35	8	43	88	8	1	8	122
2039	36	8	44	89	8	0	8	125
2040	36	8	44	91	8	0	8	127

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	21	5	26	9	1	1	3	33
2017	22	5	27	9	1	2	3	33
2018	23	5	28	9	1	2	3	34
2019	23	5	28	10	2	2	4	34
2020	24	5	29	10	2	3	5	34
2021	24	5	30	10	2	3	5	35
2022	25	5	30	10	2	3	5	36
2023	26	6	31	11	3	3	5	37
2024	26	6	32	11	3	3	5	38
2025	27	6	33	11	3	3	6	38
2026	27	6	33	11	3	3	6	39
2027	28	6	34	12	3	3	6	40
2028	29	6	35	12	4	3	6	41
2029	29	6	36	12	4	3	6	41
2030	30	7	36	12	4	3	7	42
2031	30	7	37	13	4	2	7	43
2032	31	7	38	13	5	2	7	44
2033	32	7	39	13	5	2	7	45
2034	32	7	40	14	6	2	7	46
2035	33	7	40	14	6	1	8	47
2036	34	7	41	14	7	1	8	48
2037	34	8	42	14	7	1	8	49
2038	35	8	43	15	8	1	8	49
2039	36	8	44	15	8	0	8	50
2040	36	8	44	15	8	0	8	51

3. Rain Barrels

  a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

  b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of North Richland Hills Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares North Richland Hills' current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) North Richland Hills' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in North Richland Hills' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for North Richland Hills with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	390	144	534	24	9	34	501
2016	409	146	555	31	12	42	513
2017	410	149	559	31	14	45	515
2018	412	152	563	37	16	53	510
2019	413	154	568	43	19	61	506
2020	415	157	572	55	21	76	496
2021	417	158	575	59	21	80	495
2022	419	159	578	63	21	84	495
2023	421	160	582	67	21	88	494
2024	423	162	585	71	21	92	493
2025	425	163	588	75	21	96	493
2026	428	164	591	79	21	100	492
2027	430	165	595	83	21	104	491
2028	432	166	598	87	21	107	491
2029	434	167	601	91	21	111	490
2030	436	169	605	95	21	115	489
2031	435	169	604	98	19	117	487
2032	435	169	603	101	17	118	485
2033	434	169	603	105	15	119	483
2034	433	169	602	108	13	121	481
2035	433	169	601	112	10	122	479
2036	432	169	601	115	8	123	477
2037	431	169	600	118	6	125	475
2038	431	169	599	122	4	126	473
2039	430	169	599	125	2	127	471
2040	429	169	598	129	0	129	469
2041	429	169	598	130	0	130	468
2042	429	169	597	131	0	131	466
2043	428	169	597	133	0	133	464
2044	428	169	596	134	0	134	462
2045	427	169	596	135	0	135	461
2046	427	169	596	137	0	137	459
2047	427	169	595	138	0	138	457
2048	426	169	595	139	0	139	456
2049	426	169	595	140	0	140	454
2050	426	169	594	142	0	142	452
2051	426	169	594	143	0	143	451
2052	425	169	594	145	0	145	450
2053	425	169	594	146	0	146	448
2054	425	169	594	147	0	147	447
2055	425	169	594	149	0	149	445
2056	425	169	594	150	0	150	444
2057	425	169	594	152	0	152	442
2058	425	169	594	153	0	153	441
2059	425	169	594	154	0	154	439
2060	425	169	593	156	0	156	438
2061	425	169	593	157	0	157	436
2062	425	169	593	159	0	159	435
2063	425	169	593	160	0	160	433
2064	425	169	593	162	0	162	432
2065	425	169	593	163	0	163	430
2066	425	169	593	164	0	164	429
2067	425	169	593	166	0	166	428
2068	425	169	593	167	0	167	426
2069	425	169	593	169	0	169	425
2070	425	169	593	170	0	170	423

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how North Richland Hills' quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	192	0	0	0
1	2015	65,690	188	91	534	443
2	2016	66,883	184	186	555	370
3	2017	68,076	181	283	559	276
4	2018	69,269	177	384	563	179
5-year Goal	2019	70,462	173	489	568	79
6	2020	71,655	172	513	572	59
7	2021	72,190	172	532	575	43
8	2022	72,724	171	552	578	26
9	2023	73,259	171	572	582	9
10-year Goal	2024	73,793	170	593	585	(8)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how North Richland Hills' most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	65,690	10.00	0	144	144
2	2016	66,883	10.00	0	146	146
3	2017	68,076	10.00	0	149	149
4	2018	69,269	10.00	0	152	152
5-year Goal	2019	70,462	10.00	0	154	154
6	2020	71,655	10.00	0	157	157
7	2021	72,190	10.00	0	158	158
8	2022	72,724	10.00	0	159	159
9	2023	73,259	10.00	0	160	160
10-year Goal	2024	73,793	10.00	0	162	162

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 144 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[17]
      i. 8.0% increase in 2013
      ii. 3.0% increase in 2016
   b. Estimated customer demand reduction of 2.0%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. Outdoor Landscape Evaluations

a. 475 outdoor evaluations performed since 2012
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
    i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	W.I.S.E. Guys	Water Rate Increases	TOTAL SAVINGS
2012		0.8		1
2013		1.4	64	65
2014	322	1.8	64	388
2015	324	2.1	65	390
2016	325	2.3	81	409
2017	327	1.5	82	410
2018	329	0.9	82	412
2019	330	0.5	83	413
2020	332	0.2	83	415
2021	334		83	417
2022	335		84	419
2023	337		84	421
2024	339		85	423
2025	340		85	425
2026	342		86	428
2027	344		86	430
2028	345		86	432
2029	347		87	434
2030	349		87	436
2031	348		87	435
2032	348		87	435
2033	347		87	434
2034	347		87	433
2035	346		87	433
2036	346		86	432
2037	345		86	431
2038	344		86	431
2039	344		86	430
2040	343		86	429
2041	343		86	429
2042	343		86	429
2043	343		86	428
2044	342		86	428
2045	342		85	427
2046	342		85	427
2047	341		85	427
2048	341		85	426
2049	341		85	426
2050	340		85	426
2051	340		85	426
2052	340		85	425
2053	340		85	425
2054	340		85	425
2055	340		85	425
2056	340		85	425
2057	340		85	425
2058	340		85	425
2059	340		85	425
2060	340		85	425
2061	340		85	425
2062	340		85	425
2063	340		85	425
2064	340		85	425
2065	340		85	425
2066	340		85	425
2067	340		85	425
2068	340		85	425
2069	340		85	425
2070	340		85	425

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	65,690	4.00	144
2016	66,883	4.00	146
2017	68,076	4.00	149
2018	69,269	4.00	152
2019	70,462	4.00	154
2020	71,655	4.00	157
2021	72,190	4.00	158
2022	72,724	4.00	159
2023	73,259	4.00	160
2024	73,793	4.00	162

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	409	146	555	54	31	12	42	568
2017	410	149	559	55	31	14	45	570
2018	412	152	563	55	37	16	53	565
2019	413	154	568	55	43	19	61	562
2020	415	157	572	56	55	21	76	552
2021	417	158	575	56	59	21	80	551
2022	419	159	578	56	63	21	84	551
2023	421	160	582	56	67	21	88	550
2024	423	162	585	57	71	21	92	550
2025	425	163	588	57	75	21	96	550
2026	428	164	591	57	79	21	100	549
2027	430	165	595	58	83	21	104	549
2028	432	166	598	58	87	21	107	548
2029	434	167	601	58	91	21	111	548
2030	436	169	605	58	95	21	115	548
2031	435	169	604	58	98	19	117	545
2032	435	169	603	58	101	17	118	543
2033	434	169	603	58	105	15	119	541
2034	433	169	602	58	108	13	121	539
2035	433	169	601	58	112	10	122	537
2036	432	169	601	58	115	8	123	535
2037	431	169	600	58	118	6	125	533
2038	431	169	599	58	122	4	126	531
2039	430	169	599	58	125	2	127	529
2040	429	169	598	58	129	0	129	527

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Plano Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Plano's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Plano's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Plano's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Plano with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	222	194	416	162	50	211	204
2016	1,003	194	1,197	202	62	264	933
2017	1,005	194	1,200	202	75	277	923
2018	1,008	195	1,202	242	87	330	873
2019	1,010	195	1,205	283	100	383	823
2020	1,012	196	1,208	363	112	476	732
2021	1,015	196	1,211	385	112	498	713
2022	1,017	197	1,214	407	112	520	694
2023	1,019	198	1,217	429	112	542	675
2024	1,022	199	1,220	451	112	564	656
2025	1,024	199	1,223	473	112	586	637
2026	1,026	200	1,226	495	112	608	618
2027	1,029	201	1,229	517	112	630	599
2028	1,031	201	1,232	539	112	652	581
2029	1,033	202	1,235	561	112	674	562
2030	1,036	203	1,238	583	112	696	543
2031	1,039	204	1,243	611	101	712	531
2032	1,043	205	1,247	639	90	729	519
2033	1,046	206	1,252	666	79	745	507
2034	1,050	207	1,256	694	67	762	495
2035	1,053	208	1,261	722	56	778	483
2036	1,057	208	1,266	750	45	795	471
2037	1,061	209	1,270	777	34	811	459
2038	1,064	210	1,275	805	22	827	447
2039	1,068	211	1,279	833	11	844	435
2040	1,071	212	1,284	860	0	860	423
2041	1,072	212	1,284	854	0	854	429
2042	1,072	212	1,284	848	0	848	436
2043	1,072	213	1,284	842	0	842	442
2044	1,072	213	1,285	837	0	837	448
2045	1,072	213	1,285	831	0	831	454
2046	1,072	213	1,285	825	0	825	461
2047	1,072	213	1,286	819	0	819	467
2048	1,073	213	1,286	813	0	813	473
2049	1,073	213	1,286	807	0	807	479
2050	1,073	214	1,286	801	0	801	486
2051	1,073	214	1,286	809	0	809	478
2052	1,073	214	1,286	816	0	816	470
2053	1,072	214	1,286	824	0	824	462
2054	1,072	214	1,286	832	0	832	454
2055	1,072	214	1,286	840	0	840	446
2056	1,072	214	1,286	848	0	848	438
2057	1,072	214	1,285	856	0	856	430
2058	1,072	214	1,285	864	0	864	422
2059	1,072	214	1,285	871	0	871	414
2060	1,071	214	1,285	879	0	879	406
2061	1,071	214	1,285	887	0	887	398
2062	1,071	214	1,285	895	0	895	390
2063	1,071	214	1,285	903	0	903	382
2064	1,071	214	1,285	911	0	911	374
2065	1,071	214	1,285	919	0	919	366
2066	1,071	214	1,285	927	0	927	358
2067	1,071	214	1,285	935	0	935	350
2068	1,071	214	1,285	943	0	943	342
2069	1,071	214	1,285	951	0	951	335
2070	1,071	214	1,285	958	0	958	327

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Plano's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	234	0	0	0
1	2015	265,111	232	174	416	242
2	2016	265,689	230	349	1,197	848
3	2017	266,267	229	525	1,200	675
4	2018	266,844	227	701	1,202	501
5-year Goal	2019	267,422	225	878	1,205	327
6	2020	268,000	223	1,096	1,208	112
7	2021	269,000	221	1,316	1,211	(105)
8	2022	270,000	218	1,537	1,214	(323)
9	2023	271,000	216	1,761	1,217	(544)
10-year Goal	2024	272,000	214	1,986	1,220	(766)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Plano's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	33.00	0	0	0
1	2015	265,111	31.80	116	194	77
2	2016	265,689	30.60	233	194	(39)
3	2017	266,267	29.40	350	194	(155)
4	2018	266,844	28.20	468	195	(273)
5-year Goal	2019	267,422	27.00	586	195	(390)
6	2020	268,000	26.40	646	196	(450)
7	2021	269,000	25.80	707	196	(511)
8	2022	270,000	25.20	769	197	(572)
9	2023	271,000	24.60	831	198	(633)
10-year Goal	2024	272,000	24.00	894	199	(695)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 194 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.0% increase in 2015
        ii. 5.0% increase in 2016
    b. Estimated customer demand reduction of 2.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Efforts (Peak-season Only)**
    a. Estimated savings of 2% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Foundation, 2015)
        i. Voluntary measure that is highly publicized
        ii. Conservatively estimated at 25% of full savings of a permanent, year-round ordinance with an enforcement scheme, which is has estimated savings of 8% of total demand in Region C
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Not Quantified at this Time:**
    a. WaterMyYard participation
    b. Toilet replacement program
        i. Did not want to assume savings without exact number of replacements
    c. Conservation Item Give-aways
        i. Lacked sufficient information

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	2x Watering Guidelines (Peak-season)	Conservation Item Give-aways	HE Toilets (SF) Rebate Program	TOTAL SAVINGS
2012					0
2013					0
2014					0
2015	222				222
2016	446	557			1,003
2017	447	558			1,005
2018	448	560			1,008
2019	449	561			1,010
2020	450	562			1,012
2021	451	564			1,015
2022	452	565			1,017
2023	453	566			1,019
2024	454	568			1,022
2025	455	569			1,024
2026	456	570			1,026
2027	457	571			1,029
2028	458	573			1,031
2029	459	574			1,033
2030	460	575			1,036
2031	462	577			1,039
2032	463	579			1,043
2033	465	581			1,046
2034	467	583			1,050
2035	468	585			1,053
2036	470	587			1,057
2037	471	589			1,061
2038	473	591			1,064
2039	475	593			1,068
2040	476	595			1,071
2041	476	595			1,072
2042	476	595			1,072
2043	476	595			1,072
2044	476	596			1,072
2045	476	596			1,072
2046	477	596			1,072
2047	477	596			1,072
2048	477	596			1,073
2049	477	596			1,073
2050	477	596			1,073
2051	477	596			1,073
2052	477	596			1,073
2053	477	596			1,072
2054	477	596			1,072
2055	477	596			1,072
2056	476	596			1,072
2057	476	595			1,072
2058	476	595			1,072
2059	476	595			1,072
2060	476	595			1,071
2061	476	595			1,071
2062	476	595			1,071
2063	476	595			1,071
2064	476	595			1,071
2065	476	595			1,071
2066	476	595			1,071
2067	476	595			1,071
2068	476	595			1,071
2069	476	595			1,071
2070	476	595			1,071

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	33.00	0
2015	265,111	31.00	194
2016	265,689	31.00	194
2017	266,267	31.00	194
2018	266,844	31.00	195
2019	267,422	31.00	195
2020	268,000	31.00	196
2021	269,000	31.00	196
2022	270,000	31.00	197
2023	271,000	31.00	198
2024	272,000	31.00	199

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,003	194	1,197	299	202	62	264	1,231
2017	1,005	194	1,200	299	202	75	277	1,222
2018	1,008	195	1,202	300	242	87	330	1,173
2019	1,010	195	1,205	301	283	100	383	1,123
2020	1,012	196	1,208	301	363	112	476	1,033
2021	1,015	196	1,211	302	385	112	498	1,015
2022	1,017	197	1,214	303	407	112	520	997
2023	1,019	198	1,217	303	429	112	542	979
2024	1,022	199	1,220	304	451	112	564	960
2025	1,024	199	1,223	305	473	112	586	942
2026	1,026	200	1,226	306	495	112	608	924
2027	1,029	201	1,229	306	517	112	630	906
2028	1,031	201	1,232	307	539	112	652	887
2029	1,033	202	1,235	308	561	112	674	869
2030	1,036	203	1,238	308	583	112	696	851
2031	1,039	204	1,243	309	611	101	712	840
2032	1,043	205	1,247	310	639	90	729	829
2033	1,046	206	1,252	312	666	79	745	818
2034	1,050	207	1,256	313	694	67	762	807
2035	1,053	208	1,261	314	722	56	778	797
2036	1,057	208	1,266	315	750	45	795	786
2037	1,061	209	1,270	316	777	34	811	775
2038	1,064	210	1,275	317	805	22	827	764
2039	1,068	211	1,279	318	833	11	844	753
2040	1,071	212	1,284	319	860	0	860	742

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Richardson Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Richardson's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Richardson's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Richardson's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Richardson with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	714	97	811	68	19	87	724
2016	749	96	845	85	24	109	736
2017	750	95	845	85	29	114	731
2018	751	94	845	103	33	136	709
2019	752	93	845	120	38	158	687
2020	753	92	845	154	43	197	648
2021	754	92	846	161	43	204	642
2022	755	93	848	169	43	212	636
2023	756	93	849	176	43	219	630
2024	757	93	850	183	43	226	624
2025	758	93	851	191	43	234	617
2026	759	94	852	198	43	241	611
2027	760	94	854	205	43	248	605
2028	761	94	855	213	43	256	599
2029	762	95	856	220	43	263	593
2030	762	95	857	227	43	270	587
2031	764	95	859	235	39	274	585
2032	766	96	862	243	34	278	584
2033	768	96	864	251	30	281	583
2034	770	96	866	259	26	285	581
2035	772	97	868	267	22	289	580
2036	773	97	870	275	17	292	578
2037	775	97	873	283	13	296	577
2038	777	98	875	291	9	299	575
2039	779	98	877	299	4	303	574
2040	781	99	879	307	0	307	573
2041	782	99	881	310	0	310	571
2042	784	99	883	314	0	314	569
2043	786	99	885	318	0	318	568
2044	788	100	887	321	0	321	566
2045	789	100	890	325	0	325	564
2046	791	100	892	329	0	329	563
2047	793	101	894	332	0	332	561
2048	795	101	896	336	0	336	559
2049	796	101	898	340	0	340	558
2050	798	102	900	343	0	343	556
2051	798	102	900	346	0	346	553
2052	798	102	900	349	0	349	550
2053	798	102	900	352	0	352	547
2054	798	102	899	355	0	355	544
2055	798	102	899	358	0	358	541
2056	798	102	899	361	0	361	538
2057	798	102	899	364	0	364	535
2058	798	102	899	367	0	367	532
2059	798	102	899	370	0	370	529
2060	797	102	899	373	0	373	526
2061	797	102	899	377	0	377	523
2062	798	102	899	380	0	380	520
2063	798	102	899	383	0	383	516
2064	798	102	899	386	0	386	513
2065	798	102	899	389	0	389	510
2066	798	102	899	392	0	392	507
2067	798	102	899	395	0	395	504
2068	798	102	899	398	0	398	501
2069	798	102	899	401	0	401	498
2070	798	102	899	404	0	404	495

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Richardson's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	243	0	0	0
1	2015	110,815	242	4	811	807
2	2016	109,652	242	8	845	837
3	2017	108,489	242	12	845	833
4	2018	107,326	242	16	845	830
5-year Goal	2019	106,163	242	19	845	826
6	2020	105,000	242	19	845	826
7	2021	105,320	242	19	846	827
8	2022	105,640	242	19	848	828
9	2023	105,960	242	19	849	829
10-year Goal	2024	106,280	242	19	850	831

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Richardson's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	22.40	0	0	0
1	2015	110,815	22.32	3	97	94
2	2016	109,652	22.24	6	96	90
3	2017	108,489	22.16	10	95	86
4	2018	107,326	22.08	13	94	81
5-year Goal	2019	106,163	22.00	15	93	77
6	2020	105,000	22.00	15	92	77
7	2021	105,320	22.00	15	92	77
8	2022	105,640	22.00	15	93	77
9	2023	105,960	22.00	15	93	77
10-year Goal	2024	106,280	22.00	16	93	78

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 97 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 8.25% increase in 2015
        ii. 8.25% increase in 2016
    b. Estimated customer demand reduction of 3.3%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Water Rate Increase	2x Watering Ordinance	Indoor/Outdoor Kits	TOTAL SAVINGS
			0
			0
			0
			0
			0
	681		681
32	682		714
67	683		749
67	684		750
67	685		751
67	686		752
67	686		753
67	687		754
67	688		755
67	689		756
67	690		757
67	691		758
67	692		759
67	693		760
67	694		761
67	695		762
67	695		762
67	697		764
67	699		766
67	701		768
67	703		770
67	704		772
67	706		773
67	708		775
67	710		777
67	712		779
67	713		781
67	715		782
67	717		784
67	719		786
67	720		788
67	722		789
68	724		791
68	725		793
68	727		795
68	729		796
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	730		798
68	729		797
68	729		797
68	729		798
68	729		798
68	729		798
68	729		798
68	729		798
68	729		798
68	729		798
68	729		798
68	729		798

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	22.40	0
2015	110,815	20.00	97
2016	109,652	20.00	96
2017	108,489	20.00	95
2018	107,326	20.00	94
2019	106,163	20.00	93
2020	105,000	20.00	92
2021	105,320	20.00	92
2022	105,640	20.00	93
2023	105,960	20.00	93
2024	106,280	20.00	93

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	749	96	845	114	85	24	109	850
2017	750	95	845	115	85	29	114	846
2018	751	94	845	115	103	33	136	824
2019	752	93	845	115	120	38	158	802
2020	753	92	845	115	154	43	197	763
2021	754	92	846	115	161	43	204	757
2022	755	93	848	115	169	43	212	751
2023	756	93	849	115	176	43	219	745
2024	757	93	850	116	183	43	226	739
2025	758	93	851	116	191	43	234	733
2026	759	94	852	116	198	43	241	727
2027	760	94	854	116	205	43	248	721
2028	761	94	855	116	213	43	256	715
2029	762	95	856	116	220	43	263	709
2030	762	95	857	116	227	43	270	703
2031	764	95	859	117	235	39	274	702
2032	766	96	862	117	243	34	278	701
2033	768	96	864	117	251	30	281	700
2034	770	96	866	118	259	26	285	699
2035	772	97	868	118	267	22	289	698
2036	773	97	870	118	275	17	292	697
2037	775	97	873	119	283	13	296	695
2038	777	98	875	119	291	9	299	694
2039	779	98	877	119	299	4	303	693
2040	781	99	879	120	307	0	307	692

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Rockwall Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Rockwall's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Rockwall's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Rockwall's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Rockwall with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	231	47	278	41	7	48	230
2016	290	48	338	52	8	60	278
2017	352	49	401	52	10	61	339
2018	361	50	411	62	11	73	337
2019	370	51	421	72	13	85	336
2020	379	52	431	93	15	108	324
2021	388	53	442	98	15	113	329
2022	397	55	452	103	15	118	334
2023	406	56	462	109	15	123	339
2024	415	57	473	114	15	129	344
2025	425	59	483	119	15	134	349
2026	434	60	494	124	15	139	355
2027	443	61	504	130	15	144	360
2028	452	63	514	135	15	150	365
2029	461	64	525	140	15	155	370
2030	470	65	535	145	15	160	375
2031	480	67	547	152	13	165	382
2032	491	68	559	159	12	171	389
2033	502	70	572	166	10	176	395
2034	512	72	584	173	9	182	402
2035	523	73	596	180	7	187	408
2036	533	75	608	187	6	193	415
2037	544	76	620	194	4	198	422
2038	554	78	632	201	3	204	428
2039	565	79	644	208	1	209	435
2040	575	81	656	214	0	214	441
2041	586	82	668	220	0	220	448
2042	597	84	681	226	0	226	455
2043	608	85	693	232	0	232	461
2044	618	87	705	237	0	237	468
2045	629	88	717	243	0	243	474
2046	640	90	730	249	0	249	481
2047	651	91	742	255	0	255	487
2048	661	93	754	260	0	260	494
2049	672	95	767	266	0	266	501
2050	683	96	779	272	0	272	507
2051	695	98	793	279	0	279	514
2052	707	100	807	286	0	286	521
2053	719	101	821	292	0	292	528
2054	731	103	834	299	0	299	535
2055	744	105	848	306	0	306	542
2056	756	106	862	313	0	313	549
2057	768	108	876	320	0	320	556
2058	780	110	890	327	0	327	563
2059	792	112	904	334	0	334	570
2060	804	113	918	341	0	341	577
2061	817	115	932	348	0	348	584
2062	830	117	947	356	0	356	591
2063	843	119	962	364	0	364	598
2064	856	121	977	372	0	372	605
2065	869	122	991	380	0	380	611
2066	882	124	1,006	388	0	388	618
2067	895	126	1,021	396	0	396	625
2068	908	128	1,036	403	0	403	632
2069	920	130	1,050	411	0	411	639
2070	933	132	1,065	419	0	419	646

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Rockwall's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	166	0	0	0
1	2015	42,566	165	19	278	259
2	2016	43,548	164	38	338	300
3	2017	44,529	162	59	401	342
4	2018	45,511	161	80	411	331
5-year Goal	2019	46,492	160	102	421	319
6	2020	47,474	159	114	431	317
7	2021	48,700	159	128	442	314
8	2022	49,926	158	142	452	310
9	2023	51,151	158	157	462	306
10-year Goal	2024	52,377	157	172	473	301

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Rockwall's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	6.00	0	0	0
1	2015	42,566	6.40	(6)	47	53
2	2016	43,548	6.80	(13)	48	60
3	2017	44,529	7.20	(20)	49	68
4	2018	45,511	7.60	(27)	50	76
5-year Goal	2019	46,492	8.00	(34)	51	85
6	2020	47,474	8.20	(38)	52	90
7	2021	48,700	8.40	(43)	53	96
8	2022	49,926	8.60	(47)	55	102
9	2023	51,151	8.80	(52)	56	108
10-year Goal	2024	52,377	9.00	(57)	57	115

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 47 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10% increase in 2016
        ii. 10% increase in 2017
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
   i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

   a. Estimated savings of 9.05% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
      i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	2x Watering Ordinance	TOTAL SAVINGS
2009		194	194
2010		200	200
2011		206	206
2012		213	213
2013		219	219
2014		225	225
2015		231	231
2016	53	238	290
2017	108	244	352
2018	111	250	361
2019	113	257	370
2020	116	263	379
2021	119	269	388
2022	122	276	397
2023	125	282	406
2024	127	288	415
2025	130	294	425
2026	133	301	434
2027	136	307	443
2028	138	313	452
2029	141	320	461
2030	144	326	470
2031	147	333	480
2032	150	340	491
2033	154	348	502
2034	157	355	512
2035	160	362	523
2036	163	370	533
2037	167	377	544
2038	170	384	554
2039	173	392	565
2040	176	399	575
2041	180	406	586
2042	183	414	597
2043	186	421	608
2044	190	429	618
2045	193	436	629
2046	196	444	640
2047	199	451	651
2048	203	459	661
2049	206	466	672
2050	209	474	683
2051	213	482	695
2052	217	490	707
2053	220	499	719
2054	224	507	731
2055	228	516	744
2056	232	524	756
2057	235	533	768
2058	239	541	780
2059	243	549	792
2060	247	558	804
2061	250	567	817
2062	254	576	830
2063	258	585	843
2064	262	594	856
2065	266	603	869
2066	270	611	882
2067	274	620	895
2068	278	629	908
2069	282	638	920
2070	286	647	933

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	6.00	0
2015	42,566	3.00	47
2016	43,548	3.00	48
2017	44,529	3.00	49
2018	45,511	3.00	50
2019	46,492	3.00	51
2020	47,474	3.00	52
2021	48,700	3.00	53
2022	49,926	3.00	55
2023	51,151	3.00	56
2024	52,377	3.00	57

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	290	48	338	35	52	8	60	313
2017	352	49	401	36	52	10	61	375
2018	361	50	411	37	62	11	73	375
2019	370	51	421	38	72	13	85	374
2020	379	52	431	39	93	15	108	362
2021	388	53	442	40	98	15	113	369
2022	397	55	452	41	103	15	118	375
2023	406	56	462	42	109	15	123	381
2024	415	57	473	43	114	15	129	387
2025	425	59	483	44	119	15	134	393
2026	434	60	494	45	124	15	139	399
2027	443	61	504	45	130	15	144	405
2028	452	63	514	46	135	15	150	411
2029	461	64	525	47	140	15	155	417
2030	470	65	535	48	145	15	160	424
2031	480	67	547	49	152	13	165	431
2032	491	68	559	50	159	12	171	439
2033	502	70	572	51	166	10	176	447
2034	512	72	584	53	173	9	182	454
2035	523	73	596	54	180	7	187	462
2036	533	75	608	55	187	6	193	470
2037	544	76	620	56	194	4	198	477
2038	554	78	632	57	201	3	204	485
2039	565	79	644	58	208	1	209	493
2040	575	81	656	59	214	0	214	501

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Sachse Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sachse's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Sachse's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sachse's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sachse with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	187	99	285	10	4	14	271
2016	186	102	288	12	5	17	271
2017	237	105	342	12	6	18	324
2018	237	108	345	15	7	22	323
2019	237	111	348	17	8	25	323
2020	236	114	351	22	8	31	320
2021	236	114	350	24	8	32	318
2022	236	114	350	25	8	34	317
2023	236	114	350	27	8	35	315
2024	235	114	350	28	8	36	313
2025	235	114	349	29	8	38	312
2026	235	114	349	31	8	39	310
2027	235	114	349	32	8	41	308
2028	234	114	349	33	8	42	307
2029	234	114	348	35	8	43	305
2030	234	114	348	36	8	45	304
2031	234	114	348	38	8	45	303
2032	233	114	348	39	7	46	302
2033	233	114	348	40	6	46	302
2034	233	114	348	42	5	47	301
2035	233	114	347	43	4	47	300
2036	233	114	347	44	3	48	300
2037	233	114	347	46	3	48	299
2038	233	114	347	47	2	49	298
2039	232	114	347	48	1	49	298
2040	232	114	347	50	0	50	297
2041	232	114	347	50	0	50	296
2042	232	114	347	51	0	51	296
2043	232	114	346	51	0	51	295
2044	232	114	346	52	0	52	294
2045	232	114	346	52	0	52	294
2046	232	114	346	53	0	53	293
2047	232	114	346	54	0	54	293
2048	232	114	346	54	0	54	292
2049	231	114	346	55	0	55	291
2050	231	114	346	55	0	55	291
2051	231	114	346	56	0	56	290
2052	231	114	346	56	0	56	290
2053	231	114	346	57	0	57	289
2054	231	114	346	57	0	57	289
2055	231	114	346	58	0	58	288
2056	231	114	346	58	0	58	287
2057	231	114	346	59	0	59	287
2058	231	114	346	59	0	59	286
2059	231	114	346	60	0	60	286
2060	231	114	345	60	0	60	285
2061	231	114	345	61	0	61	285
2062	231	114	345	61	0	61	284
2063	231	114	345	62	0	62	283
2064	231	114	345	63	0	63	283
2065	231	114	345	63	0	63	282
2066	231	114	345	64	0	64	282
2067	231	114	345	64	0	64	281
2068	231	114	345	65	0	65	281
2069	231	114	345	65	0	65	280
2070	231	114	345	66	0	66	280

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sachse's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	148	0	0	0
1	2015	24,554	147	11	285	274
2	2016	25,343	146	22	288	266
3	2017	26,132	144	34	342	308
4	2018	26,921	143	47	345	298
5-year Goal	2019	27,710	142	61	348	287
6	2020	28,499	141	73	351	278
7	2021	28,499	140	83	350	267
8	2022	28,499	139	94	350	257
9	2023	28,499	138	104	350	246
10-year Goal	2024	28,499	137	114	350	235

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sachse's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	26.00	0	0	0
1	2015	24,554	24.40	14	99	84
2	2016	25,343	22.80	30	102	72
3	2017	26,132	21.20	46	105	59
4	2018	26,921	19.60	63	108	45
5-year Goal	2019	27,710	18.00	81	111	30
6	2020	28,499	18.00	83	114	31
7	2021	28,499	18.00	83	114	31
8	2022	28,499	18.00	83	114	31
9	2023	28,499	18.00	83	114	31
10-year Goal	2024	28,499	18.00	83	114	31

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 99 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 15% increase in 2015
        ii. 15% increase in 2017
    b. Estimated customer demand reduction of 6.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increases	WaterMyYard	TOTAL SAVINGS
2012				0
2013				0
2014	136			136
2015	136	51		187
2016	136	51		186
2017	135	102		237
2018	135	101		237
2019	135	101		237
2020	135	101		236
2021	135	101		236
2022	135	101		236
2023	135	101		236
2024	134	101		235
2025	134	101		235
2026	134	101		235
2027	134	101		235
2028	134	100		234
2029	134	100		234
2030	134	100		234
2031	134	100		234
2032	133	100		233
2033	133	100		233
2034	133	100		233
2035	133	100		233
2036	133	100		233
2037	133	100		233
2038	133	100		233
2039	133	100		232
2040	133	100		232
2041	133	100		232
2042	133	99		232
2043	133	99		232
2044	133	99		232
2045	132	99		232
2046	132	99		232
2047	132	99		232
2048	132	99		232
2049	132	99		231
2050	132	99		231
2051	132	99		231
2052	132	99		231
2053	132	99		231
2054	132	99		231
2055	132	99		231
2056	132	99		231
2057	132	99		231
2058	132	99		231
2059	132	99		231
2060	132	99		231
2061	132	99		231
2062	132	99		231
2063	132	99		231
2064	132	99		231
2065	132	99		231
2066	132	99		231
2067	132	99		231
2068	132	99		231
2069	132	99		231
2070	132	99		231

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	26.00	0
2015	24,554	15.00	99
2016	25,343	15.00	102
2017	26,132	15.00	105
2018	26,921	15.00	108
2019	27,710	15.00	111
2020	28,499	15.00	114
2021	28,499	15.00	114
2022	28,499	15.00	114
2023	28,499	15.00	114
2024	28,499	15.00	114

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	186	102	288	23	12	5	17	294
2017	237	105	342	23	12	6	18	347
2018	237	108	345	23	15	7	22	346
2019	237	111	348	23	17	8	25	345
2020	236	114	351	23	22	8	31	342
2021	236	114	350	23	24	8	32	341
2022	236	114	350	23	25	8	34	339
2023	236	114	350	23	27	8	35	337
2024	235	114	350	23	28	8	36	336
2025	235	114	349	22	29	8	38	334
2026	235	114	349	22	31	8	39	333
2027	235	114	349	22	32	8	41	331
2028	234	114	349	22	33	8	42	329
2029	234	114	348	22	35	8	43	328
2030	234	114	348	22	36	8	45	326
2031	234	114	348	22	38	8	45	325
2032	233	114	348	22	39	7	46	325
2033	233	114	348	22	40	6	46	324
2034	233	114	348	22	42	5	47	323
2035	233	114	347	22	43	4	47	323
2036	233	114	347	22	44	3	48	322
2037	233	114	347	22	46	3	48	321
2038	233	114	347	22	47	2	49	320
2039	232	114	347	22	48	1	49	320
2040	232	114	347	22	50	0	50	319

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Saginaw Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Saginaw's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Saginaw's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Saginaw's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Saginaw with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	116	(24)	92	1	2	4	88
2016	122	(24)	98	2	3	5	93
2017	124	(25)	99	2	3	5	94
2018	125	(25)	100	2	4	6	94
2019	127	(25)	102	3	5	7	94
2020	128	(25)	103	3	5	8	94
2021	129	(26)	104	4	5	9	95
2022	131	(26)	105	4	5	9	96
2023	132	(26)	106	5	5	10	96
2024	134	(27)	107	5	5	10	97
2025	135	(27)	108	5	5	11	97
2026	136	(27)	109	6	5	11	98
2027	138	(28)	110	6	5	11	99
2028	139	(28)	111	7	5	12	99
2029	140	(28)	112	7	5	12	100
2030	142	(29)	113	7	5	13	100
2031	143	(29)	114	8	5	13	102
2032	145	(29)	115	9	4	13	103
2033	146	(30)	117	9	4	13	104
2034	148	(30)	118	10	3	13	105
2035	149	(30)	119	10	3	13	106
2036	151	(31)	120	11	2	13	107
2037	152	(31)	121	11	2	13	108
2038	154	(31)	122	12	1	13	109
2039	155	(32)	123	12	1	13	110
2040	156	(32)	124	13	0	13	112
2041	157	(32)	125	13	0	13	112
2042	158	(33)	125	14	0	14	112
2043	159	(33)	126	14	0	14	112
2044	159	(33)	126	15	0	15	112
2045	160	(33)	127	15	0	15	112
2046	161	(33)	128	16	0	16	112
2047	161	(33)	128	16	0	16	112
2048	162	(34)	129	17	0	17	112
2049	163	(34)	129	17	0	17	112
2050	164	(34)	130	18	0	18	112
2051	164	(34)	130	18	0	18	112
2052	164	(34)	130	19	0	19	111
2053	164	(34)	130	19	0	19	111
2054	164	(34)	130	19	0	19	110
2055	163	(34)	130	20	0	20	110
2056	163	(34)	130	20	0	20	109
2057	163	(34)	129	21	0	21	109
2058	163	(34)	129	21	0	21	108
2059	163	(34)	129	22	0	22	108
2060	163	(34)	129	22	0	22	107
2061	163	(34)	129	23	0	23	107
2062	163	(34)	129	23	0	23	106
2063	163	(34)	129	23	0	23	106
2064	163	(34)	129	24	0	24	106
2065	163	(34)	129	24	0	24	105
2066	163	(34)	129	25	0	25	105
2067	163	(34)	129	25	0	25	104
2068	163	(34)	129	26	0	26	104
2069	163	(34)	129	26	0	26	103
2070	163	(34)	129	26	0	26	103

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Saginaw's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	22,079	149	11	92	81
2	2016	22,264	147	23	98	75
3	2017	22,449	146	34	99	65
4	2018	22,634	144	46	100	54
5-year Goal	2019	22,819	143	58	102	43
6	2020	23,004	142	71	103	32
7	2021	23,324	140	83	104	20
8	2022	23,644	139	97	105	8
9	2023	23,963	137	110	106	(4)
10-year Goal	2024	24,283	136	124	107	(17)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Saginaw's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2015	22,079	18.80	2	(24)	(26)
2	2016	22,264	18.60	3	(24)	(28)
3	2017	22,449	18.40	5	(25)	(29)
4	2018	22,634	18.20	7	(25)	(31)
5-year Goal	2019	22,819	18.00	8	(25)	(33)
6	2020	23,004	17.80	10	(25)	(35)
7	2021	23,324	17.60	12	(26)	(37)
8	2022	23,644	17.40	14	(26)	(40)
9	2023	23,963	17.20	16	(26)	(42)
10-year Goal	2024	24,283	17.00	18	(27)	(44)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 24 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 15% increase in 2013
        ii. 5% increase in 2014
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
    a. Project initiated in service area in 2016
    b. Save Water completed work on 101 multi-family units in 2016
    c. Average monthly savings of 407,060 gallons
    d. Annualized savings of 4.88 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
        i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Save Water Co.	Water Rate Increases	TOTAL SAVINGS
2012	75			75
2013	76		28	104
2014	77		38	115
2015	77		39	116
2016	78	4.9	39	122
2017	79	4.9	40	124
2018	80	4.9	40	125
2019	81	4.9	41	127
2020	82	4.9	41	128
2021	83	4.9	42	129
2022	84	4.9	42	131
2023	85	4.9	42	132
2024	86	4.9	43	134
2025	87	4.9	43	135
2026	88	4.9	44	136
2027	89	4.9	44	138
2028	89	4.9	45	139
2029	90	4.9	45	140
2030	91	4.9	46	142
2031	92	4.9	46	143
2032	93	4.9	47	145
2033	94	4.9	47	146
2034	95	4.9	48	148
2035	96	4.9	48	149
2036	97	4.9	49	151
2037	98	4.9	49	152
2038	99	4.9	50	154
2039	100	4.9	50	155
2040	101	4.9	51	156
2041	102	4.9	51	157
2042	102	4.9	51	158
2043	102	4.9	51	159
2044	103	4.9	51	159
2045	103	4.9	52	160
2046	104	4.9	52	161
2047	104	4.9	52	161
2048	105	4.9	52	162
2049	105	4.9	53	163
2050	106	4.9	53	164
2051	106	4.9	53	164
2052	106	4.9	53	164
2053	106	4.9	53	164
2054	106	4.9	53	164
2055	106	4.9	53	163
2056	106	4.9	53	163
2057	106	4.9	53	163
2058	106	4.9	53	163
2059	106	4.9	53	163
2060	106	4.9	53	163
2061	106	4.9	53	163
2062	106	4.9	53	163
2063	106	4.9	53	163
2064	106	4.9	53	163
2065	106	4.9	53	163
2066	106	4.9	53	163
2067	106	4.9	53	163
2068	106	4.9	53	163
2069	106	4.9	53	163
2070	106	4.9	53	163

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	19.00	0
2015	22,079	22.00	(24)
2016	22,264	22.00	(24)
2017	22,449	22.00	(25)
2018	22,634	22.00	(25)
2019	22,819	22.00	(25)
2020	23,004	22.00	(25)
2021	23,324	22.00	(26)
2022	23,644	22.00	(26)
2023	23,963	22.00	(26)
2024	24,283	22.00	(27)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

---

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	122	(24)	98	13	2	3	5	106
2017	124	(25)	99	13	2	3	5	107
2018	125	(25)	100	13	2	4	6	108
2019	127	(25)	102	14	3	5	7	108
2020	128	(25)	103	14	3	5	8	108
2021	129	(26)	104	14	4	5	9	109
2022	131	(26)	105	14	4	5	9	110
2023	132	(26)	106	14	5	5	10	110
2024	134	(27)	107	14	5	5	10	111
2025	135	(27)	108	15	5	5	11	112
2026	136	(27)	109	15	6	5	11	113
2027	138	(28)	110	15	6	5	11	113
2028	139	(28)	111	15	7	5	12	114
2029	140	(28)	112	15	7	5	12	115
2030	142	(29)	113	15	7	5	13	116
2031	143	(29)	114	15	8	5	13	117
2032	145	(29)	115	16	9	4	13	118
2033	146	(30)	117	16	9	4	13	120
2034	148	(30)	118	16	10	3	13	121
2035	149	(30)	119	16	10	3	13	122
2036	151	(31)	120	16	11	2	13	123
2037	152	(31)	121	16	11	2	13	125
2038	154	(31)	122	17	12	1	13	126
2039	155	(32)	123	17	12	1	13	127
2040	156	(32)	124	17	13	0	13	128

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Sardis-Lone ELM WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sardis-Lone ELM WSC's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Sardis-Lone ELM WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sardis-Lone ELM WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sardis-Lone ELM WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	95	(61)	34	8	3	10	24
2016	98	(62)	36	9	4	13	23
2017	100	(62)	38	9	4	14	24
2018	103	(63)	40	11	5	16	24
2019	105	(63)	42	13	6	19	23
2020	108	(64)	44	17	7	23	21
2021	110	(65)	45	19	7	25	20
2022	112	(67)	46	20	7	27	19
2023	115	(68)	47	22	7	29	18
2024	117	(70)	48	24	7	30	17
2025	120	(71)	49	25	7	32	17
2026	122	(73)	50	27	7	34	16
2027	125	(74)	50	29	7	35	15
2028	127	(76)	51	31	7	37	14
2029	130	(77)	52	32	7	39	14
2030	132	(79)	53	34	7	40	13
2031	135	(81)	54	36	6	42	12
2032	138	(82)	55	38	5	44	12
2033	141	(84)	56	41	5	45	11
2034	143	(86)	58	43	4	47	11
2035	146	(88)	59	45	3	49	10
2036	149	(89)	60	48	3	50	10
2037	152	(91)	61	50	2	52	9
2038	155	(93)	62	52	1	53	8
2039	158	(95)	63	54	1	55	8
2040	160	(96)	64	57	0	57	7
2041	162	(97)	65	58	0	58	7
2042	163	(98)	65	59	0	59	6
2043	165	(99)	66	60	0	60	5
2044	166	(100)	66	62	0	62	5
2045	168	(101)	67	63	0	63	4
2046	169	(102)	67	64	0	64	3
2047	170	(102)	68	65	0	65	3
2048	172	(103)	68	67	0	67	2
2049	173	(104)	69	68	0	68	1
2050	175	(105)	70	69	0	69	0
2051	176	(106)	70	70	0	70	(0)
2052	177	(106)	70	71	0	71	(1)
2053	178	(107)	71	72	0	72	(2)
2054	179	(107)	71	73	0	73	(2)
2055	179	(108)	71	74	0	74	(3)
2056	180	(109)	72	76	0	76	(4)
2057	181	(109)	72	77	0	77	(4)
2058	182	(110)	73	78	0	78	(5)
2059	183	(110)	73	79	0	79	(6)
2060	184	(111)	73	80	0	80	(7)
2061	184	(111)	73	81	0	81	(7)
2062	184	(111)	73	81	0	81	(8)
2063	184	(111)	73	82	0	82	(9)
2064	184	(111)	73	83	0	83	(10)
2065	184	(111)	73	84	0	84	(10)
2066	184	(111)	73	84	0	84	(11)
2067	184	(111)	73	85	0	85	(12)
2068	184	(111)	73	86	0	86	(13)
2069	184	(111)	73	87	0	87	(13)
2070	184	(111)	73	87	0	87	(14)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sardis-Lone ELM WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	185	0	0	0
1	2015	14,000	179	31	34	3
2	2016	14,100	173	62	36	(26)
3	2017	14,200	167	93	38	(55)
4	2018	14,300	161	125	40	(85)
5-year Goal	2019	14,400	155	158	42	(116)
6	2020	14,500	154	164	44	(120)
7	2021	14,850	153	173	45	(128)
8	2022	15,200	152	183	46	(137)
9	2023	15,550	151	193	47	(146)
10-year Goal	2024	15,900	150	203	48	(155)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sardis-Lone ELM WSC's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	14,000	20.00	0	(61)	(61)
2	2016	14,100	20.00	0	(62)	(62)
3	2017	14,200	20.00	0	(62)	(62)
4	2018	14,300	20.00	0	(63)	(63)
5-year Goal	2019	14,400	20.00	0	(63)	(63)
6	2020	14,500	19.60	2	(64)	(66)
7	2021	14,850	19.20	4	(65)	(69)
8	2022	15,200	18.80	7	(67)	(73)
9	2023	15,550	18.40	9	(68)	(77)
10-year Goal	2024	15,900	18.00	12	(70)	(81)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 61 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 42.3% increase in 2015
    b. Estimated customer demand reduction of 8.455%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015	95	95
2016	98	98
2017	100	100
2018	103	103
2019	105	105
2020	108	108
2021	110	110
2022	112	112
2023	115	115
2024	117	117
2025	120	120
2026	122	122
2027	125	125
2028	127	127
2029	130	130
2030	132	132
2031	135	135
2032	138	138
2033	141	141
2034	143	143
2035	146	146
2036	149	149
2037	152	152
2038	155	155
2039	158	158
2040	160	160
2041	162	162
2042	163	163
2043	165	165
2044	166	166
2045	168	168
2046	169	169
2047	170	170
2048	172	172
2049	173	173
2050	175	175
2051	176	176
2052	177	177
2053	178	178
2054	179	179
2055	179	179
2056	180	180
2057	181	181
2058	182	182
2059	183	183
2060	184	184
2061	184	184
2062	184	184
2063	184	184
2064	184	184
2065	184	184
2066	184	184
2067	184	184
2068	184	184
2069	184	184
2070	184	184

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	14,000	32.00	(61)
2016	14,100	32.00	(62)
2017	14,200	32.00	(62)
2018	14,300	32.00	(63)
2019	14,400	32.00	(63)
2020	14,500	32.00	(64)
2021	14,850	32.00	(65)
2022	15,200	32.00	(67)
2023	15,550	32.00	(68)
2024	15,900	32.00	(70)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region C savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 93 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	98	(62)	36	93	9	4	13	115
2017	100	(62)	38	95	9	4	14	119
2018	103	(63)	40	97	11	5	16	121
2019	105	(63)	42	99	13	6	19	123
2020	108	(64)	44	102	17	7	23	122
2021	110	(65)	45	104	19	7	25	124
2022	112	(67)	46	106	20	7	27	125
2023	115	(68)	47	109	22	7	29	127
2024	117	(70)	48	111	24	7	30	129
2025	120	(71)	49	113	25	7	32	130
2026	122	(73)	50	116	27	7	34	132
2027	125	(74)	50	118	29	7	35	133
2028	127	(76)	51	120	31	7	37	135
2029	130	(77)	52	123	32	7	39	136
2030	132	(79)	53	125	34	7	40	138
2031	135	(81)	54	128	36	6	42	140
2032	138	(82)	55	130	38	5	44	142
2033	141	(84)	56	133	41	5	45	144
2034	143	(86)	58	136	43	4	47	146
2035	146	(88)	59	138	45	3	49	149
2036	149	(89)	60	141	48	3	50	151
2037	152	(91)	61	144	50	2	52	153
2038	155	(93)	62	146	52	1	53	155
2039	158	(95)	63	149	54	1	55	157
2040	160	(96)	64	152	57	0	57	159

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

---

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	98	(62)	36	15	9	4	13	38
2017	100	(62)	38	16	9	4	14	40
2018	103	(63)	40	16	11	5	16	40
2019	105	(63)	42	17	13	6	19	40
2020	108	(64)	44	17	17	7	23	38
2021	110	(65)	45	17	19	7	25	37
2022	112	(67)	46	18	20	7	27	37
2023	115	(68)	47	18	22	7	29	36
2024	117	(70)	48	19	24	7	30	36
2025	120	(71)	49	19	25	7	32	36
2026	122	(73)	50	19	27	7	34	35
2027	125	(74)	50	20	29	7	35	35
2028	127	(76)	51	20	31	7	37	35
2029	130	(77)	52	21	32	7	39	34
2030	132	(79)	53	21	34	7	40	34
2031	135	(81)	54	21	36	6	42	34
2032	138	(82)	55	22	38	5	44	34
2033	141	(84)	56	22	41	5	45	33
2034	143	(86)	58	23	43	4	47	33
2035	146	(88)	59	23	45	3	49	33
2036	149	(89)	60	24	48	3	50	33
2037	152	(91)	61	24	50	2	52	33
2038	155	(93)	62	25	52	1	53	33
2039	158	(95)	63	25	54	1	55	33
2040	160	(96)	64	25	57	0	57	33

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Seagoville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Seagoville's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Seagoville's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Seagoville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Seagoville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	15.4	(23)	(8)	1	1	2	(10)
2016	15.7	(24)	(8)	1	2	3	(11)
2017	15.9	(25)	(9)	1	2	3	(12)
2018	16.2	(26)	(10)	2	3	4	(14)
2019	16.5	(27)	(10)	2	3	5	(15)
2020	16.8	(28)	(11)	2	3	6	(16)
2021	17.1	(28)	(11)	3	3	6	(17)
2022	17.4	(29)	(11)	3	3	6	(17)
2023	17.7	(29)	(12)	3	3	6	(18)
2024	17.9	(30)	(12)	3	3	7	(19)
2025	18.2	(30)	(12)	4	3	7	(19)
2026	18.5	(31)	(13)	4	3	7	(20)
2027	18.8	(32)	(13)	4	3	8	(20)
2028	19.1	(32)	(13)	5	3	8	(21)
2029	19.4	(33)	(13)	5	3	8	(22)
2030	19.7	(33)	(14)	5	3	8	(22)
2031	20.0	(34)	(14)	6	3	9	(23)
2032	20.3	(35)	(14)	6	3	9	(23)
2033	20.6	(35)	(15)	6	2	9	(23)
2034	20.9	(36)	(15)	7	2	9	(24)
2035	21.2	(36)	(15)	7	2	9	(24)
2036	21.4	(37)	(15)	8	1	9	(24)
2037	21.7	(38)	(16)	8	1	9	(25)
2038	22.0	(38)	(16)	8	1	9	(25)
2039	22.3	(39)	(16)	9	0	9	(25)
2040	22.6	(39)	(17)	9	0	9	(26)
2041	23.0	(40)	(17)	10	0	10	(26)
2042	23.3	(40)	(17)	10	0	10	(27)
2043	23.6	(41)	(17)	10	0	10	(28)
2044	23.9	(42)	(18)	11	0	11	(29)
2045	24.2	(42)	(18)	11	0	11	(29)
2046	24.5	(43)	(18)	12	0	12	(30)
2047	24.8	(43)	(19)	12	0	12	(31)
2048	25.1	(44)	(19)	13	0	13	(32)
2049	25.5	(45)	(19)	13	0	13	(32)
2050	25.8	(45)	(19)	14	0	14	(33)
2051	26.1	(46)	(20)	14	0	14	(34)
2052	26.4	(46)	(20)	15	0	15	(35)
2053	26.8	(47)	(20)	15	0	15	(36)
2054	27.1	(48)	(20)	16	0	16	(36)
2055	27.4	(48)	(21)	17	0	17	(37)
2056	27.8	(49)	(21)	17	0	17	(38)
2057	28.1	(49)	(21)	18	0	18	(39)
2058	28.4	(50)	(21)	18	0	18	(40)
2059	28.8	(51)	(22)	19	0	19	(41)
2060	29.1	(51)	(22)	20	0	20	(42)
2061	29.1	(51)	(22)	20	0	20	(42)
2062	29.1	(51)	(22)	20	0	20	(42)
2063	29.1	(51)	(22)	21	0	21	(43)
2064	29.1	(51)	(22)	21	0	21	(43)
2065	29.1	(51)	(22)	21	0	21	(43)
2066	29.1	(51)	(22)	22	0	22	(44)
2067	29.1	(51)	(22)	22	0	22	(44)
2068	29.1	(51)	(22)	22	0	22	(44)
2069	29.1	(51)	(22)	23	0	23	(45)
2070	29.1	(51)	(22)	23	0	23	(45)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Seagoville's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	118	0	0	0
1	2011	15,156	116	9	(8)	(17)
2	2012	15,341	115	18	(8)	(26)
3	2013	15,525	113	27	(9)	(36)
4	2014	15,710	112	37	(10)	(46)
5-year Goal	2015	15,894	110	46	(10)	(57)
6	2016	16,486	110	51	(11)	(61)
7	2017	17,078	109	55	(11)	(66)
8	2018	17,670	109	59	(11)	(71)
9	2019	18,262	108	64	(12)	(76)
10-year Goal	2020	18,854	108	69	(12)	(81)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Seagoville's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2011	15,156	11.80	1	(23)	(24)
2	2012	15,341	11.60	2	(24)	(26)
3	2013	15,525	11.40	3	(25)	(28)
4	2014	15,710	11.20	5	(26)	(30)
5-year Goal	2015	15,894	11.00	6	(27)	(32)
6	2016	16,486	11.00	6	(28)	(34)
7	2017	17,078	11.00	6	(28)	(34)
8	2018	17,670	11.00	6	(29)	(35)
9	2019	18,262	11.00	7	(29)	(36)
10-year Goal	2020	18,854	11.00	7	(30)	(37)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 23 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012	15	14.5
2013	15	14.8
2014	15	15.1
2015	15	15.4
2016	16	15.7
2017	16	15.9
2018	16	16.2
2019	17	16.5
2020	17	16.8
2021	17	17.1
2022	17	17.4
2023	18	17.7
2024	18	17.9
2025	18	18.2
2026	19	18.5
2027	19	18.8
2028	19	19.1
2029	19	19.4
2030	20	19.7
2031	20	20.0
2032	20	20.3
2033	21	20.6
2034	21	20.9
2035	21	21.2
2036	21	21.4
2037	22	21.7
2038	22	22.0
2039	22	22.3
2040	23	22.6
2041	23	23.0
2042	23	23.3
2043	24	23.6
2044	24	23.9
2045	24	24.2
2046	25	24.5
2047	25	24.8
2048	25	25.1
2049	25	25.5
2050	26	25.8
2051	26	26.1
2052	26	26.4
2053	27	26.8
2054	27	27.1
2055	27	27.4
2056	28	27.8
2057	28	28.1
2058	28	28.4
2059	29	28.8
2060	29	29.1
2061	29	29.1
2062	29	29.1
2063	29	29.1
2064	29	29.1
2065	29	29.1
2066	29	29.1
2067	29	29.1
2068	29	29.1
2069	29	29.1
2070	29	29.1

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	12.00	0
2015	15,894	16.00	(23)
2016	16,486	16.00	(24)
2017	17,078	16.00	(25)
2018	17,670	16.00	(26)
2019	18,262	16.00	(27)
2020	18,854	16.00	(28)
2021	19,256	16.00	(28)
2022	19,658	16.00	(29)
2023	20,060	16.00	(29)
2024	20,462	16.00	(30)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 50 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	16	(24)	(8)	50	1	2	3	39
2017	16	(25)	(9)	51	1	2	3	39
2018	16	(26)	(10)	52	2	3	4	38
2019	17	(27)	(10)	53	2	3	5	38
2020	17	(28)	(11)	54	2	3	6	37
2021	17	(28)	(11)	55	3	3	6	38
2022	17	(29)	(11)	56	3	3	6	38
2023	18	(29)	(12)	57	3	3	6	38
2024	18	(30)	(12)	57	3	3	7	39
2025	18	(30)	(12)	58	4	3	7	39
2026	19	(31)	(13)	59	4	3	7	39
2027	19	(32)	(13)	60	4	3	8	40
2028	19	(32)	(13)	61	5	3	8	40
2029	19	(33)	(13)	62	5	3	8	40
2030	20	(33)	(14)	63	5	3	8	41
2031	20	(34)	(14)	64	6	3	9	41
2032	20	(35)	(14)	65	6	3	9	42
2033	21	(35)	(15)	66	6	2	9	43
2034	21	(36)	(15)	67	7	2	9	43
2035	21	(36)	(15)	68	7	2	9	44
2036	21	(37)	(15)	69	8	1	9	44
2037	22	(38)	(16)	70	8	1	9	45
2038	22	(38)	(16)	71	8	1	9	46
2039	22	(39)	(16)	71	9	0	9	46
2040	23	(39)	(17)	72	9	0	9	47

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[18]
g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	16	(24)	(8)	8	1	2	3	(3)
2017	16	(25)	(9)	9	1	2	3	(4)
2018	16	(26)	(10)	9	2	3	4	(5)
2019	17	(27)	(10)	9	2	3	5	(6)
2020	17	(28)	(11)	9	2	3	6	(7)
2021	17	(28)	(11)	9	3	3	6	(8)
2022	17	(29)	(11)	9	3	3	6	(8)
2023	18	(29)	(12)	9	3	3	6	(9)
2024	18	(30)	(12)	10	3	3	7	(9)
2025	18	(30)	(12)	10	4	3	7	(9)
2026	19	(31)	(13)	10	4	3	7	(10)
2027	19	(32)	(13)	10	4	3	8	(10)
2028	19	(32)	(13)	10	5	3	8	(11)
2029	19	(33)	(13)	10	5	3	8	(11)
2030	20	(33)	(14)	11	5	3	8	(12)
2031	20	(34)	(14)	11	6	3	9	(12)
2032	20	(35)	(14)	11	6	3	9	(12)
2033	21	(35)	(15)	11	6	2	9	(12)
2034	21	(36)	(15)	11	7	2	9	(12)
2035	21	(36)	(15)	11	7	2	9	(13)
2036	21	(37)	(15)	11	8	1	9	(13)
2037	22	(38)	(16)	12	8	1	9	(13)
2038	22	(38)	(16)	12	8	1	9	(13)
2039	22	(39)	(16)	12	9	0	9	(13)
2040	23	(39)	(17)	12	9	0	9	(14)

3. Water Rate Increase

- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 13 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	16	(24)	(8)	13	1	2	3	1
2017	16	(25)	(9)	13	1	2	3	0
2018	16	(26)	(10)	13	2	3	4	(1)
2019	17	(27)	(10)	13	2	3	5	(2)
2020	17	(28)	(11)	13	2	3	6	(3)
2021	17	(28)	(11)	14	3	3	6	(3)
2022	17	(29)	(11)	14	3	3	6	(4)
2023	18	(29)	(12)	14	3	3	6	(4)
2024	18	(30)	(12)	14	3	3	7	(4)
2025	18	(30)	(12)	15	4	3	7	(5)
2026	19	(31)	(13)	15	4	3	7	(5)
2027	19	(32)	(13)	15	4	3	8	(5)
2028	19	(32)	(13)	15	5	3	8	(6)
2029	19	(33)	(13)	15	5	3	8	(6)
2030	20	(33)	(14)	16	5	3	8	(6)
2031	20	(34)	(14)	16	6	3	9	(7)
2032	20	(35)	(14)	16	6	3	9	(7)
2033	21	(35)	(15)	16	6	2	9	(7)
2034	21	(36)	(15)	17	7	2	9	(7)
2035	21	(36)	(15)	17	7	2	9	(7)
2036	21	(37)	(15)	17	8	1	9	(7)
2037	22	(38)	(16)	17	8	1	9	(7)
2038	22	(38)	(16)	18	8	1	9	(7)
2039	22	(39)	(16)	18	9	0	9	(8)
2040	23	(39)	(17)	18	9	0	9	(8)

4. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Sherman Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sherman's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Sherman's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sherman's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sherman with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	30	134	164	20	8	28	136
2016	31	135	166	25	10	35	131
2017	31	136	167	25	12	37	131
2018	31	138	169	30	13	44	125
2019	31	139	170	35	15	51	120
2020	31	141	172	46	17	63	109
2021	31	142	173	49	17	66	107
2022	31	142	173	52	17	69	104
2023	31	143	174	55	17	72	102
2024	31	144	175	58	17	75	99
2025	31	144	175	61	17	79	97
2026	32	145	177	64	17	82	95
2027	32	146	178	68	17	85	93
2028	32	146	178	71	17	88	91
2029	32	147	179	74	17	91	88
2030	32	148	180	77	17	94	86
2031	32	149	181	81	16	96	85
2032	33	151	184	85	14	99	85
2033	33	153	186	89	12	101	85
2034	33	154	187	93	10	103	84
2035	33	156	189	97	9	105	84
2036	34	158	192	101	7	108	84
2037	34	159	193	105	5	110	83
2038	34	161	195	109	3	112	83
2039	35	163	198	113	2	114	83
2040	35	164	199	117	0	117	83
2041	36	167	203	120	0	120	83
2042	36	170	206	123	0	123	82
2043	37	172	209	126	0	126	83
2044	37	175	212	130	0	130	82
2045	38	177	215	133	0	133	82
2046	38	180	218	136	0	136	82
2047	39	183	222	139	0	139	82
2048	39	185	224	143	0	143	82
2049	40	188	228	146	0	146	82
2050	40	191	231	149	0	149	81
2051	41	196	237	156	0	156	82
2052	43	202	245	162	0	162	83
2053	44	207	251	168	0	168	83
2054	45	213	258	174	0	174	83
2055	46	218	264	181	0	181	84
2056	47	224	271	187	0	187	84
2057	48	230	278	193	0	193	84
2058	50	235	285	200	0	200	86
2059	51	241	292	206	0	206	86
2060	52	246	298	212	0	212	86
2061	54	256	310	223	0	223	87
2062	56	266	322	234	0	234	88
2063	58	276	334	246	0	246	88
2064	60	286	346	257	0	257	89
2065	62	296	358	268	0	268	90
2066	64	306	370	279	0	279	91
2067	67	315	382	290	0	290	92
2068	69	325	394	301	0	301	93
2069	71	335	406	312	0	312	94
2070	73	345	418	323	0	323	95

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sherman's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	207	0	0	0
1	2015	40,667	201	95	164	69
2	2016	41,110	194	192	166	(26)
3	2017	41,552	188	291	167	(124)
4	2018	41,995	181	392	169	(223)
5-year Goal	2019	42,437	175	496	170	(325)
6	2020	42,880	170	579	172	(407)
7	2021	43,092	165	661	173	(488)
8	2022	43,304	160	743	173	(570)
9	2023	43,516	155	826	174	(652)
10-year Goal	2024	43,728	150	910	175	(735)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sherman's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	36.00	0	0	0
1	2015	40,667	33.80	33	134	101
2	2016	41,110	31.60	66	135	69
3	2017	41,552	29.40	100	136	36
4	2018	41,995	27.20	135	138	3
5-year Goal	2019	42,437	25.00	170	139	(31)
6	2020	42,880	24.60	178	141	(38)
7	2021	43,092	24.20	186	142	(44)
8	2022	43,304	23.80	193	142	(51)
9	2023	43,516	23.40	200	143	(57)
10-year Goal	2024	43,728	23.00	207	144	(64)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 134 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 1.0% increase in 2013
        ii. 3.5% increase in 2015
    b. Estimated customer demand reduction of .9%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012		0
2013		0
2014	7	7
2015	30	30
2016	31	31
2017	31	31
2018	31	31
2019	31	31
2020	31	31
2021	31	31
2022	31	31
2023	31	31
2024	31	31
2025	31	31
2026	32	32
2027	32	32
2028	32	32
2029	32	32
2030	32	32
2031	32	32
2032	33	33
2033	33	33
2034	33	33
2035	33	33
2036	34	34
2037	34	34
2038	34	34
2039	35	35
2040	35	35
2041	36	36
2042	36	36
2043	37	37
2044	37	37
2045	38	38
2046	38	38
2047	39	39
2048	39	39
2049	40	40
2050	40	40
2051	41	41
2052	43	43
2053	44	44
2054	45	45
2055	46	46
2056	47	47
2057	48	48
2058	50	50
2059	51	51
2060	52	52
2061	54	54
2062	56	56
2063	58	58
2064	60	60
2065	62	62
2066	64	64
2067	67	67
2068	69	69
2069	71	71
2070	73	73

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	36.00	0
2015	40,667	27.00	134
2016	41,110	27.00	135
2017	41,552	27.00	136
2018	41,995	27.00	138
2019	42,437	27.00	139
2020	42,880	27.00	141
2021	43,092	27.00	142
2022	43,304	27.00	142
2023	43,516	27.00	143
2024	43,728	27.00	144

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 271 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	31	134	165	271	25	10	35	401
2017	31	135	166	272	25	12	37	401
2018	31	136	167	273	30	13	44	397
2019	31	138	169	274	35	15	51	392
2020	31	139	170	275	46	17	63	382
2021	31	141	172	276	49	17	66	382
2022	31	142	173	277	52	17	69	380
2023	31	142	173	278	55	17	72	378
2024	31	143	174	278	58	17	75	377
2025	31	144	175	279	61	17	79	375
2026	32	144	176	280	64	17	82	375
2027	32	145	177	281	68	17	85	373
2028	32	146	178	282	71	17	88	372
2029	32	146	178	283	74	17	91	370
2030	32	147	179	284	77	17	94	369
2031	32	148	180	286	81	16	96	370
2032	33	149	182	289	85	14	99	373
2033	33	151	184	292	89	12	101	375
2034	33	153	186	295	93	10	103	377
2035	33	154	187	297	97	9	105	379
2036	34	156	190	300	101	7	108	382
2037	34	158	192	303	105	5	110	385
2038	34	159	193	306	109	3	112	387
2039	35	161	196	308	113	2	114	390
2040	35	163	198	311	117	0	117	392

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	31	134	165	45	25	10	35	175
2017	31	135	166	46	25	12	37	175
2018	31	136	167	46	30	13	44	169
2019	31	138	169	46	35	15	51	164
2020	31	139	170	46	46	17	63	154
2021	31	141	172	46	49	17	66	152
2022	31	142	173	46	52	17	69	150
2023	31	142	173	46	55	17	72	147
2024	31	143	174	47	58	17	75	145
2025	31	144	175	47	61	17	79	143
2026	32	144	176	47	64	17	82	142
2027	32	145	177	47	68	17	85	139
2028	32	146	178	47	71	17	88	137
2029	32	146	178	47	74	17	91	135
2030	32	147	179	48	77	17	94	132
2031	32	148	180	48	81	16	96	131
2032	33	149	182	48	85	14	99	132
2033	33	151	184	49	89	12	101	132
2034	33	153	186	49	93	10	103	132
2035	33	154	187	50	97	9	105	132
2036	34	156	190	50	101	7	108	133
2037	34	158	192	51	105	5	110	132
2038	34	159	193	51	109	3	112	132
2039	35	161	196	52	113	2	114	133
2040	35	163	198	52	117	0	117	133

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Southlake Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Southlake's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Southlake's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Southlake's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Southlake with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	301	153	454	30	8	38	416
2016	323	151	473	37	11	47	426
2017	325	149	474	37	13	50	424
2018	328	146	474	44	15	59	415
2019	331	144	475	52	17	69	406
2020	334	142	476	66	19	85	391
2021	338	144	481	71	19	90	392
2022	342	146	487	75	19	94	393
2023	345	148	493	79	19	98	395
2024	349	149	499	84	19	103	396
2025	353	151	504	88	19	107	398
2026	357	153	510	92	19	111	399
2027	361	155	516	97	19	115	400
2028	365	156	522	101	19	120	402
2029	369	158	527	105	19	124	403
2030	373	160	533	110	19	128	405
2031	379	163	542	115	17	132	410
2032	386	165	551	121	15	136	415
2033	392	168	560	127	13	140	420
2034	398	171	569	133	11	144	425
2035	404	174	578	139	9	148	429
2036	410	176	587	145	8	152	434
2037	417	179	596	151	6	156	439
2038	423	182	605	157	4	160	444
2039	429	185	614	163	2	164	449
2040	435	187	623	168	0	168	454
2041	442	190	632	173	0	173	459
2042	448	193	641	177	0	177	464
2043	454	196	650	181	0	181	468
2044	460	198	659	186	0	186	473
2045	467	201	668	190	0	190	478
2046	473	204	677	194	0	194	482
2047	479	207	686	199	0	199	487
2048	486	209	695	203	0	203	492
2049	492	212	704	208	0	208	497
2050	498	215	713	212	0	212	501
2051	505	218	722	217	0	217	506
2052	511	221	732	221	0	221	510
2053	518	223	741	226	0	226	515
2054	524	226	750	231	0	231	519
2055	530	229	759	236	0	236	523
2056	537	232	768	241	0	241	528
2057	543	234	778	245	0	245	532
2058	550	237	787	250	0	250	537
2059	556	240	796	255	0	255	541
2060	562	243	805	260	0	260	546
2061	569	246	815	265	0	265	550
2062	576	249	824	270	0	270	554
2063	582	251	833	276	0	276	558
2064	589	254	843	281	0	281	561
2065	595	257	852	287	0	287	565
2066	602	260	861	292	0	292	569
2067	608	263	871	297	0	297	573
2068	615	265	880	303	0	303	577
2069	621	268	889	308	0	308	581
2070	628	271	899	314	0	314	585

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Southlake's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years..

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	333	0	0	0
1	2015	29,941	332	13	454	441
2	2016	29,516	331	26	473	448
3	2017	29,092	329	38	474	435
4	2018	28,667	328	50	474	424
5-year Goal	2019	28,243	327	62	475	413
6	2020	27,818	324	93	476	383
7	2021	28,168	321	127	481	354
8	2022	28,517	317	162	487	325
9	2023	28,867	314	198	493	295
10-year Goal	2024	29,217	311	235	499	264

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Southlake's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	25.00	0	0	0
1	2015	29,941	25.00	0	153	153
2	2016	29,516	25.00	0	151	151
3	2017	29,092	25.00	0	149	149
4	2018	28,667	25.00	0	146	146
5-year Goal	2019	28,243	25.00	0	144	144
6	2020	27,818	25.00	0	142	142
7	2021	28,168	25.00	0	144	144
8	2022	28,517	25.00	0	146	146
9	2023	28,867	25.00	0	148	148
10-year Goal	2024	29,217	25.00	0	149	149

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 153 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 2.12% increase in 2015
        ii. 2.49% increase in 2016
    b. Estimated customer demand reduction of .9%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **Outdoor landscape evaluations for single family (SF) customers**
    a. 1200 outdoor evaluations performed since 2011
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
        i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	2x Watering Ordinance	W.I.S.E. Guys Surveys	TOTAL SAVINGS
2011			1.6	2
2012			2.9	3
2013			3.8	4
2014		279	4.5	283
2015	14.1	282	4.8	301
2016	32.1	286	4.8	323
2017	32.5	289	3.2	325
2018	32.9	293	1.9	328
2019	33.3	296	1.0	331
2020	33.7	300	0.3	334
2021	34.1	303		338
2022	34.5	307		342
2023	34.9	311		345
2024	35.3	314		349
2025	35.7	318		353
2026	36.1	321		357
2027	36.5	325		361
2028	36.9	328		365
2029	37.3	332		369
2030	37.7	335		373
2031	38.4	341		379
2032	39.0	347		386
2033	39.6	352		392
2034	40.2	358		398
2035	40.9	363		404
2036	41.5	369		410
2037	42.1	374		417
2038	42.8	380		423
2039	43.4	386		429
2040	44.0	391		435
2041	44.6	397		442
2042	45.3	403		448
2043	45.9	408		454
2044	46.6	414		460
2045	47.2	420		467
2046	47.8	425		473
2047	48.5	431		479
2048	49.1	437		486
2049	49.7	442		492
2050	50.4	448		498
2051	51.0	454		505
2052	51.7	459		511
2053	52.3	465		518
2054	53.0	471		524
2055	53.6	477		530
2056	54.3	482		537
2057	54.9	488		543
2058	55.6	494		550
2059	56.2	500		556
2060	56.9	506		562
2061	57.5	511		569
2062	58.2	517		576
2063	58.9	523		582
2064	59.5	529		589
2065	60.2	535		595
2066	60.8	541		602
2067	61.5	547		608
2068	62.2	553		615
2069	62.8	558		621
2070	63.5	564		628

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	25.00	0
2015	29,941	11.00	153
2016	29,516	11.00	151
2017	29,092	11.00	149
2018	28,667	11.00	146
2019	28,243	11.00	144
2020	27,818	11.00	142
2021	28,168	11.00	144
2022	28,517	11.00	146
2023	28,867	11.00	148
2024	29,217	11.00	149

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
 i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
 i. This was the most common percentage of residential use among participating utilities in this project.
 ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	323	151	473	48	37	11	47	474
2017	325	149	474	48	37	13	50	472
2018	328	146	474	49	44	15	59	464
2019	331	144	475	50	52	17	69	456
2020	334	142	476	50	66	19	85	441
2021	338	144	481	51	71	19	90	443
2022	342	146	487	51	75	19	94	445
2023	345	148	493	52	79	19	98	447
2024	349	149	499	53	84	19	103	449
2025	353	151	504	53	88	19	107	451
2026	357	153	510	54	92	19	111	453
2027	361	155	516	54	97	19	115	455
2028	365	156	522	55	101	19	120	457
2029	369	158	527	56	105	19	124	459
2030	373	160	533	56	110	19	128	461
2031	379	163	542	57	115	17	132	467
2032	386	165	551	58	121	15	136	473
2033	392	168	560	59	127	13	140	479
2034	398	171	569	60	133	11	144	484
2035	404	174	578	61	139	9	148	490
2036	410	176	587	62	145	8	152	496
2037	417	179	596	63	151	6	156	502
2038	423	182	605	64	157	4	160	508
2039	429	185	614	65	163	2	164	514
2040	435	187	623	66	168	0	168	520

2. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Springtown Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Springtown's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Springtown's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Springtown's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Springtown with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.5	(2)	(2)	0	0	1	(3)
2016	10.5	(2)	8	0	1	1	7
2017	10.9	(3)	8	0	1	1	7
2018	11.3	(3)	9	0	1	1	7
2019	11.7	(3)	9	1	1	1	7
2020	12.0	(3)	9	1	1	2	7
2021	12.4	(3)	9	1	1	2	8
2022	12.8	(3)	10	1	1	2	8
2023	13.2	(3)	10	1	1	2	8
2024	13.5	(3)	10	1	1	2	8
2025	13.9	(3)	10	1	1	2	8
2026	14.3	(4)	11	1	1	2	8
2027	14.7	(4)	11	1	1	2	9
2028	15.0	(4)	11	1	1	2	9
2029	15.4	(4)	12	2	1	3	9
2030	15.8	(4)	12	2	1	3	9
2031	15.8	(4)	12	2	1	3	9
2032	15.8	(4)	12	2	1	3	9
2033	15.7	(4)	12	2	1	3	9
2034	15.7	(4)	12	2	1	2	9
2035	15.7	(4)	12	2	0	2	9
2036	15.7	(4)	12	2	0	2	9
2037	15.7	(4)	12	2	0	2	9
2038	15.7	(4)	12	2	0	2	9
2039	15.6	(4)	12	2	0	2	9
2040	15.6	(4)	12	2	0	2	9
2041	15.6	(4)	12	2	0	2	9
2042	15.6	(4)	12	2	0	2	9
2043	15.6	(4)	12	3	0	3	9
2044	15.6	(4)	12	3	0	3	9
2045	15.6	(4)	12	3	0	3	9
2046	15.6	(4)	12	3	0	3	9
2047	15.6	(4)	12	3	0	3	9
2048	15.6	(4)	12	3	0	3	8
2049	15.5	(4)	12	3	0	3	8
2050	15.5	(4)	12	3	0	3	8
2051	15.5	(4)	12	3	0	3	8
2052	15.5	(4)	12	3	0	3	8
2053	15.5	(4)	12	3	0	3	8
2054	15.5	(4)	12	4	0	4	8
2055	15.5	(4)	12	4	0	4	8
2056	15.5	(4)	12	4	0	4	8
2057	15.5	(4)	12	4	0	4	8
2058	15.5	(4)	12	4	0	4	8
2059	15.5	(4)	12	4	0	4	8
2060	15.5	(4)	12	4	0	4	8
2061	15.5	(4)	12	4	0	4	7
2062	15.5	(4)	11	4	0	4	7
2063	15.5	(4)	11	4	0	4	7
2064	15.5	(4)	11	4	0	4	7
2065	15.5	(4)	11	4	0	4	7
2066	15.5	(4)	11	4	0	4	7
2067	15.5	(4)	11	5	0	5	7
2068	15.5	(4)	11	5	0	5	7
2069	15.5	(4)	11	5	0	5	7
2070	15.5	(4)	11	5	0	5	7

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Springtown's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	129	0	0	0
1	2012	2,888	128	1	(2)	(4)
2	2013	2,999	126	3	(2)	(5)
3	2014	3,111	125	5	(2)	(7)
4	2015	3,223	123	7	(2)	(8)
5-year Goal	2016	3,394	122	9	8	(1)
6	2017	3,565	121	10	8	(2)
7	2018	3,737	121	11	9	(3)
8	2019	3,908	120	13	9	(4)
9	2020	4,079	120	14	9	(5)
10-year Goal	2021	4,221	119	15	9	(6)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Springtown's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	24.00	0	0	0
1	2012	2,888	24.00	0	(2)	(2)
2	2013	2,999	24.00	0	(2)	(2)
3	2014	3,111	24.00	0	(2)	(2)
4	2015	3,223	24.00	0	(2)	(2)
5-year Goal	2016	3,394	24.00	0	(2)	(2)
6	2017	3,565	22.80	2	(3)	(4)
7	2018	3,737	21.60	3	(3)	(6)
8	2019	3,908	20.40	5	(3)	(8)
9	2020	4,079	19.20	7	(3)	(10)
10-year Goal	2021	4,221	18.00	9	(3)	(12)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 10% increase in 2016
    b. Estimated customer demand reduction of 2.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	0.5	0.5
2016	10.5	10.5
2017	10.9	10.9
2018	11.3	11.3
2019	11.7	11.7
2020	12.0	12.0
2021	12.4	12.4
2022	12.8	12.8
2023	13.2	13.2
2024	13.5	13.5
2025	13.9	13.9
2026	14.3	14.3
2027	14.7	14.7
2028	15.0	15.0
2029	15.4	15.4
2030	15.8	15.8
2031	15.8	15.8
2032	15.8	15.8
2033	15.7	15.7
2034	15.7	15.7
2035	15.7	15.7
2036	15.7	15.7
2037	15.7	15.7
2038	15.7	15.7
2039	15.6	15.6
2040	15.6	15.6
2041	15.6	15.6
2042	15.6	15.6
2043	15.6	15.6
2044	15.6	15.6
2045	15.6	15.6
2046	15.6	15.6
2047	15.6	15.6
2048	15.6	15.6
2049	15.5	15.5
2050	15.5	15.5
2051	15.5	15.5
2052	15.5	15.5
2053	15.5	15.5
2054	15.5	15.5
2055	15.5	15.5
2056	15.5	15.5
2057	15.5	15.5
2058	15.5	15.5
2059	15.5	15.5
2060	15.5	15.5
2061	15.5	15.5
2062	15.5	15.5
2063	15.5	15.5
2064	15.5	15.5
2065	15.5	15.5
2066	15.5	15.5
2067	15.5	15.5
2068	15.5	15.5
2069	15.5	15.5
2070	15.5	15.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	24.00	0
2015	3,223	26.00	(2)
2016	3,394	26.00	(2)
2017	3,565	26.00	(3)
2018	3,737	26.00	(3)
2019	3,908	26.00	(3)
2020	4,079	26.00	(3)
2021	4,221	26.00	(3)
2022	4,363	26.00	(3)
2023	4,505	26.00	(3)
2024	4,647	26.00	(3)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region C savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 11 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	11	(2)	8	11	0	1	1	18
2017	11	(3)	8	11	0	1	1	18
2018	11	(3)	9	11	0	1	1	19
2019	12	(3)	9	12	1	1	1	19
2020	12	(3)	9	12	1	1	2	19
2021	12	(3)	9	12	1	1	2	20
2022	13	(3)	10	13	1	1	2	21
2023	13	(3)	10	13	1	1	2	21
2024	14	(3)	10	14	1	1	2	22
2025	14	(3)	10	14	1	1	2	22
2026	14	(4)	11	14	1	1	2	23
2027	15	(4)	11	15	1	1	2	23
2028	15	(4)	11	15	1	1	2	24
2029	15	(4)	12	15	2	1	3	24
2030	16	(4)	12	16	2	1	3	25
2031	16	(4)	12	16	2	1	3	25
2032	16	(4)	12	16	2	1	3	25
2033	16	(4)	12	16	2	1	3	25
2034	16	(4)	12	16	2	1	2	25
2035	16	(4)	12	16	2	0	2	25
2036	16	(4)	12	16	2	0	2	25
2037	16	(4)	12	16	2	0	2	25
2038	16	(4)	12	16	2	0	2	25
2039	16	(4)	12	16	2	0	2	25
2040	16	(4)	12	16	2	0	2	25

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]
g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	11	(2)	8	2	0	1	1	9
2017	11	(3)	8	2	0	1	1	10
2018	11	(3)	9	2	0	1	1	10
2019	12	(3)	9	2	1	1	1	10
2020	12	(3)	9	3	1	1	2	10
2021	12	(3)	9	3	1	1	2	10
2022	13	(3)	10	3	1	1	2	10
2023	13	(3)	10	3	1	1	2	11
2024	14	(3)	10	3	1	1	2	11
2025	14	(3)	10	3	1	1	2	11
2026	14	(4)	11	3	1	1	2	11
2027	15	(4)	11	3	1	1	2	12
2028	15	(4)	11	3	1	1	2	12
2029	15	(4)	12	3	2	1	3	12
2030	16	(4)	12	3	2	1	3	12
2031	16	(4)	12	3	2	1	3	12
2032	16	(4)	12	3	2	1	3	12
2033	16	(4)	12	3	2	1	3	13
2034	16	(4)	12	3	2	1	2	13
2035	16	(4)	12	3	2	0	2	13
2036	16	(4)	12	3	2	0	2	13
2037	16	(4)	12	3	2	0	2	13
2038	16	(4)	12	3	2	0	2	13
2039	16	(4)	12	3	2	0	2	13
2040	16	(4)	12	3	2	0	2	13

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Terrell Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Terrell's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Terrell's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Terrell's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Terrell with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	7	7	8	3	11	(3)
2016	0	49	49	10	4	13	35
2017	0	51	51	10	4	14	37
2018	0	53	53	12	5	17	36
2019	0	55	55	13	6	19	35
2020	0	57	57	17	7	24	33
2021	0	61	61	21	7	27	34
2022	0	66	66	24	7	30	36
2023	0	71	71	27	7	34	37
2024	0	75	75	31	7	37	38
2025	0	80	80	34	7	40	40
2026	0	85	85	37	7	44	41
2027	0	89	89	41	7	47	42
2028	0	94	94	44	7	50	44
2029	0	99	99	47	7	54	45
2030	0	103	103	51	7	57	46
2031	0	106	106	54	6	60	46
2032	0	108	108	57	5	63	45
2033	0	110	110	61	5	65	45
2034	0	113	113	64	4	68	45
2035	0	115	115	67	3	71	44
2036	0	117	117	71	3	73	44
2037	0	119	119	74	2	76	43
2038	0	122	122	78	1	79	43
2039	0	124	124	81	1	82	42
2040	0	126	126	84	0	84	42
2041	0	129	129	88	0	88	42
2042	0	132	132	91	0	91	42
2043	0	135	135	94	0	94	42
2044	0	138	138	97	0	97	41
2045	0	141	141	100	0	100	41
2046	0	144	144	103	0	103	41
2047	0	147	147	106	0	106	41
2048	0	150	150	109	0	109	41
2049	0	154	154	113	0	113	41
2050	0	157	157	116	0	116	41
2051	0	159	159	119	0	119	40
2052	0	162	162	122	0	122	40
2053	0	164	164	125	0	125	39
2054	0	167	167	128	0	128	38
2055	0	169	169	132	0	132	37
2056	0	172	172	135	0	135	37
2057	0	174	174	138	0	138	36
2058	0	177	177	141	0	141	35
2059	0	179	179	144	0	144	35
2060	0	182	182	148	0	148	34
2061	0	185	185	152	0	152	33
2062	0	188	188	156	0	156	32
2063	0	190	190	159	0	159	31
2064	0	193	193	163	0	163	30
2065	0	196	196	167	0	167	29
2066	0	199	199	171	0	171	28
2067	0	202	202	175	0	175	27
2068	0	205	205	179	0	179	26
2069	0	208	208	183	0	183	25
2070	0	211	211	187	0	187	24

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Terrell's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	158	0	0	0
1	2015	19,599	158	3	7	4
2	2016	20,433	157	6	49	43
3	2017	21,267	157	9	51	41
4	2018	22,101	156	13	53	40
5-year Goal	2019	22,935	156	17	55	38
6	2020	23,769	155	23	57	34
7	2021	25,732	155	30	61	31
8	2022	27,696	154	38	66	28
9	2023	29,659	154	48	71	23
10-year Goal	2024	31,623	153	58	75	18

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Terrell's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	19,599	15.00	0	7	7
2	2016	20,433	15.00	0	49	49
3	2017	21,267	15.00	0	51	51
4	2018	22,101	15.00	0	53	53
5-year Goal	2019	22,935	15.00	0	55	55
6	2020	23,769	15.00	0	57	57
7	2021	25,732	15.00	0	61	61
8	2022	27,696	15.00	0	66	66
9	2023	29,659	15.00	0	71	71
10-year Goal	2024	31,623	15.00	0	75	75

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 7 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	19,599	14.00	7
2016	20,433	8.47	49
2017	21,267	8.47	51
2018	22,101	8.47	53
2019	22,935	8.47	55
2020	23,769	8.47	57
2021	25,732	8.47	61
2022	27,696	8.47	66
2023	29,659	8.47	71
2024	31,623	8.47	75

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

  a. Potentially 6.95% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

  b. Savings could be 63 MG per year with current demand.

  c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	49	49	63	10	4	13	99
2017	0	51	51	70	10	4	14	107
2018	0	53	53	77	12	5	17	113
2019	0	55	55	84	13	6	19	120
2020	0	57	57	91	17	7	24	124
2021	0	61	61	98	21	7	27	133
2022	0	66	66	105	24	7	30	141
2023	0	71	71	113	27	7	34	149
2024	0	75	75	120	31	7	37	158
2025	0	80	80	127	34	7	40	166
2026	0	85	85	134	37	7	44	175
2027	0	89	89	141	41	7	47	183
2028	0	94	94	148	44	7	50	191
2029	0	99	99	155	47	7	54	200
2030	0	103	103	162	51	7	57	208
2031	0	106	106	165	54	6	60	211
2032	0	108	108	169	57	5	63	214
2033	0	110	110	172	61	5	65	217
2034	0	113	113	175	64	4	68	220
2035	0	115	115	179	67	3	71	223
2036	0	117	117	182	71	3	73	226
2037	0	119	119	185	74	2	76	229
2038	0	122	122	189	78	1	79	232
2039	0	124	124	192	81	1	82	235
2040	0	126	126	196	84	0	84	237

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	49	49	12	10	4	13	48
2017	0	51	51	14	10	4	14	50
2018	0	53	53	15	12	5	17	51
2019	0	55	55	16	13	6	19	52
2020	0	57	57	18	17	7	24	50
2021	0	61	61	19	21	7	27	53
2022	0	66	66	20	24	7	30	56
2023	0	71	71	22	27	7	34	59
2024	0	75	75	23	31	7	37	61
2025	0	80	80	24	34	7	40	64
2026	0	85	85	26	37	7	44	67
2027	0	89	89	27	41	7	47	69
2028	0	94	94	28	44	7	50	72
2029	0	99	99	30	47	7	54	75
2030	0	103	103	31	51	7	57	78
2031	0	106	106	32	54	6	60	78
2032	0	108	108	32	57	5	63	78
2033	0	110	110	33	61	5	65	78
2034	0	113	113	34	64	4	68	78
2035	0	115	115	34	67	3	71	79
2036	0	117	117	35	71	3	73	79
2037	0	119	119	36	74	2	76	79
2038	0	122	122	36	78	1	79	79
2039	0	124	124	37	81	1	82	79
2040	0	126	126	38	84	0	84	80

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 18 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	49	49	18	10	4	13	54
2017	0	51	51	20	10	4	14	57
2018	0	53	53	22	12	5	17	58
2019	0	55	55	24	13	6	19	60
2020	0	57	57	26	17	7	24	59
2021	0	61	61	28	21	7	27	63
2022	0	66	66	30	24	7	30	66
2023	0	71	71	32	27	7	34	69
2024	0	75	75	34	31	7	37	73
2025	0	80	80	36	34	7	40	76
2026	0	85	85	38	37	7	44	79
2027	0	89	89	40	41	7	47	83
2028	0	94	94	43	44	7	50	86
2029	0	99	99	45	47	7	54	90
2030	0	103	103	47	51	7	57	93
2031	0	106	106	48	54	6	60	93
2032	0	108	108	49	57	5	63	94
2033	0	110	110	49	61	5	65	95
2034	0	113	113	50	64	4	68	95
2035	0	115	115	51	67	3	71	96
2036	0	117	117	52	71	3	73	96
2037	0	119	119	53	74	2	76	97
2038	0	122	122	54	78	1	79	97
2039	0	124	124	55	81	1	82	98
2040	0	126	126	56	84	0	84	98

4. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of The Colony Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares The Colony's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) The Colony's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in The Colony's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for The Colony with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	18	33	51	4	6	9	42
2016	33	34	67	5	7	12	55
2017	32	34	67	5	8	13	54
2018	31	35	67	6	10	16	51
2019	31	36	67	7	11	18	49
2020	31	37	68	8	13	21	47
2021	31	38	68	10	13	22	46
2022	31	38	69	11	13	23	46
2023	31	39	70	12	13	24	46
2024	32	39	71	13	13	25	46
2025	32	40	72	14	13	26	45
2026	32	40	73	15	13	27	45
2027	33	41	74	16	13	28	45
2028	33	41	74	17	13	30	45
2029	33	42	75	18	13	31	45
2030	34	42	76	19	13	32	44
2031	34	43	77	20	11	31	45
2032	34	43	77	21	10	31	46
2033	34	43	78	22	9	31	47
2034	34	44	78	23	8	31	47
2035	35	44	78	24	6	31	48
2036	35	44	79	25	5	30	49
2037	35	44	79	26	4	30	49
2038	35	45	80	28	3	30	50
2039	35	45	80	29	1	30	51
2040	36	45	81	30	0	30	51
2041	36	46	82	31	0	31	51
2042	36	46	82	32	0	32	50
2043	36	46	83	34	0	34	49
2044	37	47	84	35	0	35	49
2045	37	47	84	36	0	36	48
2046	37	48	85	37	0	37	48
2047	38	48	86	39	0	39	47
2048	38	49	86	40	0	40	46
2049	38	49	87	41	0	41	46
2050	39	49	88	43	0	43	45
2051	39	49	88	44	0	44	44
2052	39	49	88	45	0	45	43
2053	39	49	88	46	0	46	42
2054	39	49	88	47	0	47	41
2055	39	49	88	48	0	48	40
2056	39	49	88	49	0	49	39
2057	39	49	88	50	0	50	38
2058	39	49	88	51	0	51	37
2059	39	49	88	52	0	52	35
2060	38	49	88	53	0	53	34
2061	38	49	88	55	0	55	33
2062	38	49	88	56	0	56	32
2063	38	49	88	57	0	57	31
2064	38	49	88	58	0	58	30
2065	38	49	88	59	0	59	29
2066	38	49	88	60	0	60	28
2067	38	49	88	61	0	61	27
2068	38	49	88	62	0	62	26
2069	38	49	88	63	0	63	25
2070	38	49	88	64	0	64	24

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how The Colony's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	123	0	0	0
1	2015	44,704	123	3	51	48
2	2016	45,963	123	7	67	60
3	2017	47,222	122	10	67	56
4	2018	48,482	122	14	67	53
5-year Goal	2019	49,741	122	18	67	49
6	2020	51,000	122	22	68	46
7	2021	51,700	122	26	68	42
8	2022	52,400	121	31	69	39
9	2023	53,100	121	35	70	35
10-year Goal	2024	53,800	121	39	71	32

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how The Colony's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	44,704	14.80	3	33	29
2	2016	45,963	14.60	7	34	27
3	2017	47,222	14.40	10	34	24
4	2018	48,482	14.20	14	35	21
5-year Goal	2019	49,741	14.00	18	36	18
6	2020	51,000	13.80	22	37	15
7	2021	51,700	13.60	26	38	11
8	2022	52,400	13.40	31	38	8
9	2023	53,100	13.20	35	39	4
10-year Goal	2024	53,800	13.00	39	39	0

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility’s water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 33 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3.0% increase in 2015
        ii. 3.0% increase in 2016
    b. Estimated customer demand reduction of 1.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; TWDB, 2013)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Outdoor landscape evaluations for single family (SF) customers**
    a. 910 outdoor evaluations performed since 2012
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

d. Greater savings during peak periods
e. Lesser savings during off-peak periods
b. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	Outdoor Audits	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012		1.5	1.5
2013		2.6	2.6
2014		3.5	3.5
2015	14	4.1	18.4
2016	29	4.4	33.4
2017	29	2.9	32.2
2018	30	1.7	31.4
2019	30	0.9	30.9
2020	30	0.3	30.6
2021	31		30.7
2022	31		31.0
2023	31		31.4
2024	32		31.7
2025	32		32.1
2026	32		32.4
2027	33		32.7
2028	33		33.1
2029	33		33.4
2030	34		33.8
2031	34		33.9
2032	34		34.1
2033	34		34.3
2034	34		34.5
2035	35		34.7
2036	35		34.9
2037	35		35.1
2038	35		35.2
2039	35		35.4
2040	36		35.6
2041	36		35.9
2042	36		36.2
2043	36		36.5
2044	37		36.8
2045	37		37.1
2046	37		37.4
2047	38		37.7
2048	38		38.0
2049	38		38.3
2050	39		38.5
2051	39		38.5
2052	39		38.5
2053	39		38.5
2054	39		38.5
2055	39		38.5
2056	39		38.5
2057	39		38.5
2058	39		38.5
2059	39		38.5
2060	38		38.5
2061	38		38.5
2062	38		38.5
2063	38		38.5
2064	38		38.5
2065	38		38.5
2066	38		38.5
2067	38		38.5
2068	38		38.5
2069	38		38.5
2070	38		38.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	44,704	13.00	33
2016	45,963	13.00	34
2017	47,222	13.00	34
2018	48,482	13.00	35
2019	49,741	13.00	36
2020	51,000	13.00	37
2021	51,700	13.00	38
2022	52,400	13.00	38
2023	53,100	13.00	39
2024	53,800	13.00	39

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region C savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 193 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	33	34	67	193	5	7	12	248
2017	32	34	67	196	5	8	13	249
2018	31	35	67	198	6	10	16	249
2019	31	36	67	200	7	11	18	249
2020	31	37	68	202	8	13	21	249
2021	31	38	68	205	10	13	22	251
2022	31	38	69	207	11	13	23	253
2023	31	39	70	209	12	13	24	255
2024	32	39	71	211	13	13	25	257
2025	32	40	72	214	14	13	26	259
2026	32	40	73	216	15	13	27	261
2027	33	41	74	218	16	13	28	263
2028	33	41	74	221	17	13	30	265
2029	33	42	75	223	18	13	31	267
2030	34	42	76	225	19	13	32	270
2031	34	43	77	226	20	11	31	271
2032	34	43	77	228	21	10	31	273
2033	34	43	78	229	22	9	31	275
2034	34	44	78	230	23	8	31	277
2035	35	44	78	231	24	6	31	279
2036	35	44	79	232	25	5	30	281
2037	35	44	79	234	26	4	30	283
2038	35	45	80	235	28	3	30	285
2039	35	45	80	236	29	1	30	287
2040	36	45	81	237	30	0	30	289

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	33	34	67	32	5	7	12	88
2017	32	34	67	33	5	8	13	86
2018	31	35	67	33	6	10	16	84
2019	31	36	67	34	7	11	18	83
2020	31	37	68	34	8	13	21	81
2021	31	38	68	34	10	13	22	80
2022	31	38	69	35	11	13	23	81
2023	31	39	70	35	12	13	24	81
2024	32	39	71	35	13	13	25	81
2025	32	40	72	36	14	13	26	81
2026	32	40	73	36	15	13	27	81
2027	33	41	74	37	16	13	28	82
2028	33	41	74	37	17	13	30	82
2029	33	42	75	37	18	13	31	82
2030	34	42	76	38	19	13	32	82
2031	34	43	77	38	20	11	31	83
2032	34	43	77	38	21	10	31	84
2033	34	43	78	38	22	9	31	85
2034	34	44	78	39	23	8	31	86
2035	35	44	78	39	24	6	31	87
2036	35	44	79	39	25	5	30	87
2037	35	44	79	39	26	4	30	88
2038	35	45	80	39	28	3	30	89
2039	35	45	80	40	29	1	30	90
2040	36	45	81	40	30	0	30	91

3. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Tioga Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus,

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Tioga's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Tioga's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Tioga's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Tioga with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	9.9	2.1	12.0	0	0.1	0.1	11.9
2016	10.3	2.1	12.4	0	0.2	0.2	12.3
2017	10.3	2.2	12.5	0	0.2	0.2	12.3
2018	10.4	2.2	12.6	0	0.3	0.3	12.3
2019	10.4	2.2	12.6	0	0.3	0.3	12.3
2020	10.5	2.2	12.7	0	0.3	0.3	12.4
2021	10.5	2.2	12.7	0	0.3	0.4	12.4
2022	10.6	2.2	12.8	0	0.3	0.4	12.4
2023	10.6	2.3	12.9	0	0.3	0.4	12.4
2024	10.6	2.3	12.9	0	0.3	0.5	12.5
2025	10.7	2.3	13.0	0	0.3	0.5	12.5
2026	10.7	2.3	13.1	0	0.3	0.5	12.5
2027	10.8	2.3	13.1	0	0.3	0.6	12.6
2028	10.8	2.4	13.2	0	0.3	0.6	12.6
2029	10.9	2.4	13.2	0	0.3	0.6	12.6
2030	10.9	2.4	13.3	0	0.3	0.7	12.7
2031	11.0	2.4	13.4	0	0.3	0.7	12.7
2032	11.0	2.4	13.5	0	0.3	0.7	12.8
2033	11.1	2.4	13.5	0	0.3	0.7	12.9
2034	11.2	2.5	13.6	0	0.3	0.7	13.0
2035	11.2	2.5	13.7	0	0.3	0.7	13.0
2036	11.3	2.5	13.8	0	0.3	0.7	13.1
2037	11.3	2.5	13.9	0	0.3	0.7	13.2
2038	11.4	2.5	13.9	0	0.3	0.7	13.3
2039	11.5	2.6	14.0	0	0.3	0.7	13.4
2040	11.5	2.6	14.1	0	0.3	0.7	13.4
2041	11.6	2.6	14.2	0	0.3	0.7	13.5
2042	11.7	2.6	14.3	0	0.3	0.7	13.6
2043	11.7	2.6	14.4	0	0.3	0.7	13.6
2044	11.8	2.7	14.5	0	0.3	0.8	13.7
2045	11.9	2.7	14.6	0	0.3	0.8	13.7
2046	11.9	2.7	14.6	1	0.3	0.8	13.8
2047	12.0	2.7	14.7	1	0.3	0.9	13.9
2048	12.1	2.7	14.8	1	0.3	0.9	13.9
2049	12.2	2.8	14.9	1	0.3	0.9	14.0
2050	12.2	2.8	15.0	1	0.3	1.0	14.0
2051	14.9	3.4	18.3	1	0.3	1.1	17.2
2052	17.6	4.0	21.6	1	0.3	1.3	20.3
2053	20.3	4.6	24.9	1	0.3	1.5	23.4
2054	23.0	5.2	28.2	1	0.3	1.6	26.6
2055	25.6	5.9	31.5	1	0.3	1.8	29.7
2056	28.3	6.5	34.8	2	0.3	2.0	32.9
2057	31.0	7.1	38.1	2	0.3	2.1	36.0
2058	33.7	7.7	41.4	2	0.3	2.3	39.1
2059	36.4	8.3	44.7	2	0.3	2.4	42.3
2060	39.1	8.9	48.0	2	0.3	2.6	45.4
2061	40.5	9.3	49.8	2	0.3	2.8	47.0
2062	42.0	9.6	51.6	3	0.3	2.9	48.6
2063	43.4	9.9	53.3	3	0.3	3.1	50.2
2064	44.8	10.3	55.1	3	0.3	3.3	51.9
2065	46.3	10.6	56.9	3	0.3	3.4	53.5
2066	47.7	10.9	58.7	3	0.3	3.6	55.1
2067	49.2	11.3	60.4	3	0.3	3.7	56.7
2068	50.6	11.6	62.2	4	0.3	3.9	58.3
2069	52.1	11.9	64.0	4	0.3	4.1	59.9
2070	53.5	12.3	65.8	4	0.3	4.2	61.5

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Tioga's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	110	0.0	0	0
1	2015	835	110	0.1	12.0	11.9
2	2016	841	110	0.1	12.4	12.3
3	2017	847	109	0.2	12.5	12.3
4	2018	853	109	0.2	12.6	12.3
5-year Goal	2019	859	109	0.3	12.6	12.3
6	2020	865	109	0.4	12.7	12.3
7	2021	872	109	0.4	12.7	12.3
8	2022	879	108	0.5	12.8	12.3
9	2023	886	108	0.6	12.9	12.3
10-year Goal	2024	893	108	0.7	12.9	12.3

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Tioga's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2015	835	13.80	0.1	2.1	2.1
2	2016	841	13.60	0.1	2.1	2.0
3	2017	847	13.40	0.2	2.2	2.0
4	2018	853	13.20	0.2	2.2	1.9
5-year Goal	2019	859	13.00	0.3	2.2	1.9
6	2020	865	12.60	0.4	2.2	1.8
7	2021	872	12.20	0.6	2.2	1.7
8	2022	879	11.80	0.7	2.2	1.5
9	2023	886	11.40	0.8	2.3	1.4
10-year Goal	2024	893	11.00	1.0	2.3	1.3

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 2.1 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 13.0% increase in 2014
        ii. 0.5% increase in 2016
    b. Estimated customer demand reduction of 2.7%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	9.8	10
2015	9.9	10
2016	10.3	10
2017	10.3	10
2018	10.4	10
2019	10.4	10
2020	10.5	10
2021	10.5	11
2022	10.6	11
2023	10.6	11
2024	10.6	11
2025	10.7	11
2026	10.7	11
2027	10.8	11
2028	10.8	11
2029	10.9	11
2030	10.9	11
2031	11.0	11
2032	11.0	11
2033	11.1	11
2034	11.2	11
2035	11.2	11
2036	11.3	11
2037	11.3	11
2038	11.4	11
2039	11.5	11
2040	11.5	12
2041	11.6	12
2042	11.7	12
2043	11.7	12
2044	11.8	12
2045	11.9	12
2046	11.9	12
2047	12.0	12
2048	12.1	12
2049	12.2	12
2050	12.2	12
2051	14.9	15
2052	17.6	18
2053	20.3	20
2054	23.0	23
2055	25.6	26
2056	28.3	28
2057	31.0	31
2058	33.7	34
2059	36.4	36
2060	39.1	39
2061	40.5	41
2062	42.0	42
2063	43.4	43
2064	44.8	45
2065	46.3	46
2066	47.7	48
2067	49.2	49
2068	50.6	51
2069	52.1	52
2070	53.5	53

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.00	0
2015	835	7.00	2.1
2016	841	7.00	2.1
2017	847	7.00	2.2
2018	853	7.00	2.2
2019	859	7.00	2.2
2020	865	7.00	2.2
2021	872	7.00	2.2
2022	879	7.00	2.2
2023	886	7.00	2.3
2024	893	7.00	2.3

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 6.53% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - **b.** Savings could be 25 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	10	2	12	25	0	0	0	37
2017	10	2	13	25	0	0	0	37
2018	10	2	13	25	0	0	0	37
2019	10	2	13	25	0	0	0	38
2020	10	2	13	25	0	0	0	38
2021	11	2	13	25	0	0	0	38
2022	11	2	13	26	0	0	0	38
2023	11	2	13	26	0	0	0	38
2024	11	2	13	26	0	0	0	38
2025	11	2	13	26	0	0	0	38
2026	11	2	13	26	0	0	1	38
2027	11	2	13	26	0	0	1	39
2028	11	2	13	26	0	0	1	39
2029	11	2	13	26	0	0	1	39
2030	11	2	13	26	0	0	1	39
2031	11	2	13	27	0	0	1	39
2032	11	2	13	27	0	0	1	39
2033	11	2	14	27	0	0	1	40
2034	11	2	14	27	0	0	1	40
2035	11	2	14	27	0	0	1	40
2036	11	2	14	27	0	0	1	40
2037	11	3	14	27	0	0	1	41
2038	11	3	14	28	0	0	1	41
2039	11	3	14	28	0	0	1	41
2040	12	3	14	28	0	0	1	41

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	10	2	12	5	0	0	0	17
2017	10	2	13	5	0	0	0	17
2018	10	2	13	5	0	0	0	17
2019	10	2	13	5	0	0	0	18
2020	10	2	13	5	0	0	0	18
2021	11	2	13	5	0	0	0	18
2022	11	2	13	5	0	0	0	18
2023	11	2	13	5	0	0	0	18
2024	11	2	13	5	0	0	0	18
2025	11	2	13	5	0	0	0	18
2026	11	2	13	5	0	0	1	18
2027	11	2	13	5	0	0	1	18
2028	11	2	13	5	0	0	1	18
2029	11	2	13	5	0	0	1	18
2030	11	2	13	5	0	0	1	18
2031	11	2	13	5	0	0	1	18
2032	11	2	13	5	0	0	1	18
2033	11	2	14	6	0	0	1	18
2034	11	2	14	6	0	0	1	19
2035	11	2	14	6	0	0	1	19
2036	11	2	14	6	0	0	1	19
2037	11	3	14	6	0	0	1	19
2038	11	3	14	6	0	0	1	19
2039	11	3	14	6	0	0	1	19
2040	12	3	14	6	0	0	1	19

3. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Town of Trophy Club Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Trophy Club's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Trophy Club's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Trophy Club's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Trophy Club with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	192	(13)	179	29	4	34	145
2016	192	(13)	179	37	6	42	136
2017	192	(14)	178	37	7	43	135
2018	192	(14)	177	44	8	52	126
2019	192	(15)	177	51	9	60	117
2020	192	(15)	176	66	10	76	100
2021	192	(15)	176	67	10	78	99
2022	191	(15)	176	69	10	79	97
2023	191	(15)	176	71	10	81	95
2024	191	(15)	176	72	10	82	93
2025	191	(15)	176	74	10	84	92
2026	191	(15)	176	76	10	86	90
2027	191	(15)	176	77	10	87	88
2028	191	(15)	176	79	10	89	87
2029	191	(15)	175	80	10	91	85
2030	191	(15)	175	82	10	92	83
2031	191	(15)	175	84	9	93	82
2032	191	(15)	175	85	8	94	82
2033	190	(15)	175	87	7	94	81
2034	190	(15)	175	89	6	95	80
2035	190	(15)	175	90	5	95	80
2036	190	(15)	175	92	4	96	79
2037	190	(15)	175	94	3	97	78
2038	190	(15)	175	95	2	97	77
2039	190	(15)	175	97	1	98	77
2040	190	(15)	175	99	0	99	76
2041	190	(15)	175	99	0	99	75
2042	190	(15)	175	100	0	100	75
2043	190	(15)	175	101	0	101	74
2044	190	(15)	175	101	0	101	73
2045	190	(15)	175	102	0	102	73
2046	190	(15)	175	102	0	102	72
2047	190	(15)	174	103	0	103	71
2048	190	(15)	174	104	0	104	71
2049	190	(15)	174	104	0	104	70
2050	190	(15)	174	105	0	105	69
2051	190	(15)	174	106	0	106	69
2052	190	(15)	174	106	0	106	68
2053	190	(15)	174	107	0	107	67
2054	190	(15)	174	108	0	108	67
2055	190	(15)	174	108	0	108	66
2056	190	(15)	174	109	0	109	65
2057	190	(15)	174	110	0	110	65
2058	190	(15)	174	110	0	110	64
2059	190	(15)	174	111	0	111	64
2060	190	(15)	174	111	0	111	63
2061	190	(15)	174	112	0	112	62
2062	190	(15)	174	113	0	113	62
2063	190	(15)	174	113	0	113	61
2064	190	(15)	174	114	0	114	60
2065	190	(15)	174	115	0	115	60
2066	190	(15)	174	115	0	115	59
2067	190	(15)	174	116	0	116	58
2068	190	(15)	174	117	0	117	58
2069	190	(15)	174	117	0	117	57
2070	190	(15)	174	118	0	118	56

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Trophy Club's quantified savings from its implemented activities compare with 5- and 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	211	0	0	0
1	2015	11,759	209	9	179	171
2	2016	12,207	207	18	179	161
3	2017	12,655	205	28	178	150
4	2018	13,104	203	38	177	139
5-year Goal	2019	13,552	201	49	177	127
6	2020	14,000	199	62	176	114
7	2021	14,000	197	74	176	103
8	2022	14,000	194	85	176	91
9	2023	14,000	192	96	176	80
10-year Goal	2024	14,000	190	107	176	69

12 In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Trophy Club's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	11,759	17.00	0	(13)	(13)
2	2016	12,207	17.00	0	(13)	(13)
3	2017	12,655	17.00	0	(14)	(14)
4	2018	13,104	17.00	0	(14)	(14)
5-year Goal	2019	13,552	17.00	0	(15)	(15)
6	2020	14,000	17.00	0	(15)	(15)
7	2021	14,000	17.00	0	(15)	(15)
8	2022	14,000	17.00	0	(15)	(15)
9	2023	14,000	17.00	0	(15)	(15)
10-year Goal	2024	14,000	17.00	0	(15)	(15)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Loss of 13 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[16]
        i. 8.0% increase in 2014
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2012	160		160
2013	160		160
2014	160	32	192
2015	160	32	192
2016	160	32	192
2017	160	32	192
2018	160	32	192
2019	160	32	192
2020	160	32	192
2021	160	32	192
2022	160	32	191
2023	159	32	191
2024	159	32	191
2025	159	32	191
2026	159	32	191
2027	159	32	191
2028	159	32	191
2029	159	32	191
2030	159	32	191
2031	159	32	191
2032	159	32	191
2033	159	32	190
2034	159	32	190
2035	159	32	190
2036	159	32	190
2037	159	32	190
2038	158	32	190
2039	158	32	190
2040	158	32	190
2041	158	32	190
2042	158	32	190
2043	158	32	190
2044	158	32	190
2045	158	32	190
2046	158	32	190
2047	158	32	190
2048	158	32	190
2049	158	32	190
2050	158	32	190
2051	158	32	190
2052	158	32	190
2053	158	32	190
2054	158	32	190
2055	158	32	190
2056	158	32	190
2057	158	32	190
2058	158	32	190
2059	158	32	190
2060	158	32	190
2061	158	32	190
2062	158	32	190
2063	158	32	190
2064	158	32	190
2065	158	32	190
2066	158	32	190
2067	158	32	190
2068	158	32	190
2069	158	32	190
2070	158	32	190

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	11,759	20.00	(13)
2016	12,207	20.00	(13)
2017	12,655	20.00	(14)
2018	13,104	20.00	(14)
2019	13,552	20.00	(15)
2020	14,000	20.00	(15)
2021	14,000	20.00	(15)
2022	14,000	20.00	(15)
2023	14,000	20.00	(15)
2024	14,000	20.00	(15)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	192	(13)	179	27	37	6	42	163
2017	192	(14)	178	27	37	7	43	162
2018	192	(14)	177	27	44	8	52	153
2019	192	(15)	177	27	51	9	60	143
2020	192	(15)	176	27	66	10	76	127
2021	192	(15)	176	27	67	10	78	125
2022	191	(15)	176	27	69	10	79	124
2023	191	(15)	176	27	71	10	81	122
2024	191	(15)	176	27	72	10	82	120
2025	191	(15)	176	27	74	10	84	118
2026	191	(15)	176	27	76	10	86	117
2027	191	(15)	176	27	77	10	87	115
2028	191	(15)	176	27	79	10	89	113
2029	191	(15)	175	27	80	10	91	111
2030	191	(15)	175	27	82	10	92	110
2031	191	(15)	175	27	84	9	93	109
2032	191	(15)	175	27	85	8	94	108
2033	190	(15)	175	27	87	7	94	108
2034	190	(15)	175	27	89	6	95	107
2035	190	(15)	175	27	90	5	95	106
2036	190	(15)	175	27	92	4	96	105
2037	190	(15)	175	27	94	3	97	105
2038	190	(15)	175	27	95	2	97	104
2039	190	(15)	175	27	97	1	98	103
2040	190	(15)	175	27	99	0	99	103

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of University Park Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares University Park's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) University Park's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in University Park's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for University Park with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	220	18	238	4	6	9	229
2016	240	18	258	5	7	11	247
2017	239	18	258	5	8	13	245
2018	239	18	258	5	10	15	243
2019	239	19	257	6	11	17	240
2020	238	19	257	8	12	21	237
2021	238	19	257	9	12	21	236
2022	238	19	257	10	12	22	234
2023	237	19	256	11	12	23	233
2024	237	19	256	11	12	24	232
2025	237	19	256	12	12	25	231
2026	236	19	255	13	12	25	230
2027	236	19	255	14	12	26	229
2028	236	19	255	15	12	27	227
2029	235	19	254	15	12	28	226
2030	235	19	254	16	12	29	225
2031	235	19	254	17	11	28	225
2032	235	19	253	18	10	28	226
2033	234	19	253	19	9	27	226
2034	234	19	253	19	7	27	226
2035	234	19	252	20	6	26	226
2036	233	19	252	21	5	26	226
2037	233	19	252	22	4	25	226
2038	233	19	252	23	2	25	227
2039	233	19	251	23	1	25	227
2040	232	19	251	24	0	24	227
2041	232	19	251	25	0	25	226
2042	232	19	251	26	0	26	225
2043	232	19	251	26	0	26	224
2044	232	19	251	27	0	27	223
2045	232	19	250	28	0	28	222
2046	231	19	250	29	0	29	221
2047	231	19	250	30	0	30	220
2048	231	19	250	30	0	30	220
2049	231	19	250	31	0	31	219
2050	231	19	250	32	0	32	218
2051	231	19	250	33	0	33	217
2052	231	19	250	34	0	34	216
2053	231	19	250	34	0	34	215
2054	231	19	250	35	0	35	214
2055	231	19	249	36	0	36	213
2056	231	19	249	37	0	37	213
2057	231	19	249	38	0	38	212
2058	231	19	249	38	0	38	211
2059	231	19	249	39	0	39	210
2060	231	19	249	40	0	40	209
2061	231	19	249	41	0	41	208
2062	231	19	249	42	0	42	208
2063	231	19	249	42	0	42	207
2064	231	19	249	43	0	43	206
2065	231	19	249	44	0	44	205
2066	231	19	249	45	0	45	205
2067	231	19	249	46	0	46	204
2068	231	19	249	46	0	46	203
2069	231	19	249	47	0	47	202
2070	231	19	249	48	0	48	201

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how University Park's quantified savings from its implemented activities compare with 5- and 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	256	0	0	0
1	2015	24,759	254	16	238	222
2	2016	24,945	252	33	258	225
3	2017	25,131	251	50	258	208
4	2018	25,316	249	67	258	191
5-year Goal	2019	25,502	247	84	257	174
6	2020	25,688	247	86	257	171
7	2021	25,688	247	88	257	169
8	2022	25,688	246	90	257	167
9	2023	25,688	246	92	256	164
10-year Goal	2024	25,688	246	94	256	162

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how University Park's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	30.00	0	0	0
1	2015	24,759	29.00	9	18	9
2	2016	24,945	28.00	18	18	0
3	2017	25,131	27.00	28	18	(9)
4	2018	25,316	26.00	37	18	(18)
5-year Goal	2019	25,502	25.00	47	19	(28)
6	2020	25,688	25.00	47	19	(28)
7	2021	25,688	25.00	47	19	(28)
8	2022	25,688	25.00	47	19	(28)
9	2023	25,688	25.00	47	19	(28)
10-year Goal	2024	25,688	25.00	47	19	(28)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

a. Easy-to-use website with conservation tips and water rates
b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of 18 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[16]
        i. 4.0% increase in 2014
        ii. 4.0% increase in 2015
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2012			0
2013			0
2014	200		200
2015	200	20	220
2016	200	40	240
2017	200	40	239
2018	199	40	239
2019	199	40	239
2020	199	40	238
2021	198	40	238
2022	198	40	238
2023	198	40	237
2024	198	40	237
2025	197	39	237
2026	197	39	236
2027	197	39	236
2028	196	39	236
2029	196	39	235
2030	196	39	235
2031	196	39	235
2032	195	39	235
2033	195	39	234
2034	195	39	234
2035	195	39	234
2036	195	39	233
2037	194	39	233
2038	194	39	233
2039	194	39	233
2040	194	39	232
2041	194	39	232
2042	193	39	232
2043	193	39	232
2044	193	39	232
2045	193	39	232
2046	193	39	231
2047	193	39	231
2048	193	39	231
2049	193	39	231
2050	192	38	231
2051	192	38	231
2052	192	38	231
2053	192	38	231
2054	192	38	231
2055	192	38	231
2056	192	38	231
2057	192	38	231
2058	192	38	231
2059	192	38	231
2060	192	38	231
2061	192	38	231
2062	192	38	231
2063	192	38	231
2064	192	38	231
2065	192	38	231
2066	192	38	231
2067	192	38	231
2068	192	38	231
2069	192	38	231
2070	192	38	231

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	30.00	0
2015	24,759	28.00	18
2016	24,945	28.00	18
2017	25,131	28.00	18
2018	25,316	28.00	18
2019	25,502	28.00	19
2020	25,688	28.00	19
2021	25,688	28.00	19
2022	25,688	28.00	19
2023	25,688	28.00	19
2024	25,688	28.00	19

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[18]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	240	18	258	33	5	7	11	280
2017	239	18	258	33	5	8	13	278
2018	239	18	258	33	5	10	15	276
2019	239	19	257	33	6	11	17	273
2020	238	19	257	33	8	12	21	270
2021	238	19	257	33	9	12	21	269
2022	238	19	257	33	10	12	22	268
2023	237	19	256	33	11	12	23	266
2024	237	19	256	33	11	12	24	265
2025	237	19	256	33	12	12	25	264
2026	236	19	255	33	13	12	25	263
2027	236	19	255	33	14	12	26	262
2028	236	19	255	33	15	12	27	260
2029	235	19	254	33	15	12	28	259
2030	235	19	254	33	16	12	29	258
2031	235	19	254	33	17	11	28	258
2032	235	19	253	33	18	10	28	258
2033	234	19	253	33	19	9	27	258
2034	234	19	253	33	19	7	27	259
2035	234	19	252	33	20	6	26	259
2036	233	19	252	33	21	5	26	259
2037	233	19	252	33	22	4	25	259
2038	233	19	252	33	23	2	25	259
2039	233	19	251	32	23	1	25	259
2040	232	19	251	32	24	0	24	259

2. Rain Barrel
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Van Alstyne Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Van Alstyne's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Van Alstyne's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Van Alstyne's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD[6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Van Alstyne with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2011	0	0	0	0	0	0	0
2012	0	-	0	0	0	0	(0)
2013	0	-	0	0	0	0	(0)
2014	12	-	12	0	0	1	12
2015	12	(38)	(26)	0	0	1	(26)
2016	15	(39)	(24)	0	1	1	(25)
2017	15	(40)	(25)	0	1	1	(26)
2018	15	(40)	(25)	0	1	1	(26)
2019	16	(41)	(26)	1	1	1	(27)
2020	16	(42)	(26)	1	1	2	(28)
2021	16	(43)	(27)	1	1	2	(29)
2022	16	(44)	(28)	1	1	2	(29)
2023	17	(45)	(28)	1	1	2	(30)
2024	17	(46)	(29)	1	1	2	(31)
2025	17	(47)	(30)	1	1	2	(31)
2026	18	(48)	(30)	1	1	2	(32)
2027	18	(49)	(31)	1	1	2	(33)
2028	18	(49)	(31)	1	1	2	(34)
2029	18	(50)	(32)	1	1	2	(34)
2030	19	(51)	(33)	1	1	2	(35)
2031	19	(52)	(33)	1	1	2	(36)
2032	19	(53)	(34)	1	1	2	(36)
2033	19	(54)	(34)	2	1	2	(37)
2034	20	(55)	(35)	2	1	2	(37)
2035	20	(56)	(36)	2	0	2	(38)
2036	20	(57)	(36)	2	0	2	(39)
2037	21	(57)	(37)	2	0	2	(39)
2038	21	(58)	(37)	2	0	2	(40)
2039	21	(59)	(38)	2	0	2	(40)
2040	21	(60)	(39)	2	0	2	(41)
2041	22	(61)	(39)	2	0	2	(42)
2042	22	(62)	(40)	3	0	3	(43)
2043	22	(63)	(41)	3	0	3	(43)
2044	23	(64)	(41)	3	0	3	(44)
2045	23	(65)	(42)	3	0	3	(45)
2046	23	(66)	(43)	3	0	3	(46)
2047	24	(67)	(43)	3	0	3	(47)
2048	24	(68)	(44)	3	0	3	(47)
2049	25	(69)	(45)	3	0	3	(48)
2050	25	(70)	(45)	4	0	4	(49)
2051	30	(84)	(54)	4	0	4	(59)
2052	34	(97)	(63)	5	0	5	(68)
2053	39	(110)	(71)	6	0	6	(78)
2054	44	(124)	(80)	7	0	7	(87)
2055	48	(137)	(89)	8	0	8	(97)
2056	53	(150)	(97)	9	0	9	(106)
2057	58	(164)	(106)	10	0	10	(116)
2058	62	(177)	(115)	11	0	11	(126)
2059	67	(190)	(123)	12	0	12	(135)
2060	72	(204)	(132)	13	0	13	(145)
2061	74	(212)	(137)	14	0	14	(151)
2062	77	(220)	(142)	14	0	14	(157)
2063	80	(227)	(148)	15	0	15	(163)
2064	83	(235)	(153)	16	0	16	(169)
2065	85	(243)	(158)	17	0	17	(175)
2066	88	(251)	(163)	18	0	18	(181)
2067	91	(259)	(168)	19	0	19	(187)
2068	94	(267)	(173)	19	0	19	(193)
2069	97	(275)	(178)	20	0	20	(199)
2070	99	(283)	(184)	21	0	21	(205)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Van Alstyne's quantified savings from its implemented activities compare with 5- and 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	133	0	0	0
1	2015	3,344	132	2	(26)	(27)
2	2016	3,422	130	3	(24)	(27)
3	2017	3,500	129	5	(25)	(30)
4	2018	3,579	127	7	(25)	(33)
5-year Goal	2019	3,657	126	9	(26)	(35)
6	2020	3,735	125	11	(26)	(38)
7	2021	3,815	124	13	(27)	(40)
8	2022	3,894	122	15	(28)	(43)
9	2023	3,974	121	17	(28)	(45)
10-year Goal	2024	4,053	120	19	(29)	(48)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Van Alstyne's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.10	0	0	0
1	2015	3,344	13.82	0	(38)	(38)
2	2016	3,422	13.54	1	(39)	(39)
3	2017	3,500	13.26	1	(40)	(41)
4	2018	3,579	12.98	1	(40)	(42)
5-year Goal	2019	3,657	12.70	2	(41)	(43)
6	2020	3,735	12.46	2	(42)	(44)
7	2021	3,815	12.22	3	(43)	(46)
8	2022	3,894	11.98	3	(44)	(47)
9	2023	3,974	11.74	3	(45)	(48)
10-year Goal	2024	4,053	11.50	4	(46)	(50)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Loss of 38 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[16]
        i. 7.0% increase in 2016
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increase	TOTAL SAVINGS
2012			0
2013			0
2014	12		12
2015	12		12
2016	13	2.2	15
2017	13	2.2	15
2018	13	2.3	15
2019	13	2.3	16
2020	13	2.4	16
2021	14	2.4	16
2022	14	2.4	16
2023	14	2.5	17
2024	14	2.5	17
2025	15	2.6	17
2026	15	2.6	18
2027	15	2.6	18
2028	15	2.7	18
2029	16	2.7	18
2030	16	2.8	19
2031	16	2.8	19
2032	16	2.9	19
2033	17	2.9	19
2034	17	2.9	20
2035	17	3.0	20
2036	17	3.0	20
2037	18	3.1	21
2038	18	3.1	21
2039	18	3.2	21
2040	18	3.2	21
2041	19	3.2	22
2042	19	3.3	22
2043	19	3.3	22
2044	19	3.4	23
2045	20	3.4	23
2046	20	3.5	23
2047	20	3.5	24
2048	21	3.6	24
2049	21	3.6	25
2050	21	3.7	25
2051	25	4.4	30
2052	29	5.1	34
2053	33	5.8	39
2054	37	6.5	44
2055	41	7.2	48
2056	45	7.9	53
2057	49	8.6	58
2058	53	9.3	62
2059	57	10.0	67
2060	61	10.7	72
2061	63	11.1	74
2062	66	11.5	77
2063	68	11.9	80
2064	70	12.3	83
2065	73	12.7	85
2066	75	13.1	88
2067	77	13.6	91
2068	80	14.0	94
2069	82	14.4	97
2070	85	14.8	99

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.00	0
2015	3,344	45.00	(38)
2016	3,422	45.00	(39)
2017	3,500	45.00	(40)
2018	3,579	45.00	(40)
2019	3,657	45.00	(41)
2020	3,735	45.00	(42)
2021	3,815	45.00	(43)
2022	3,894	45.00	(44)
2023	3,974	45.00	(45)
2024	4,053	45.00	(46)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	15	(39)	(24)	2	0	1	1	(23)
2017	15	(40)	(25)	2	0	1	1	(23)
2018	15	(40)	(25)	2	0	1	1	(24)
2019	16	(41)	(26)	2	1	1	1	(25)
2020	16	(42)	(26)	2	1	1	2	(26)
2021	16	(43)	(27)	2	1	1	2	(26)
2022	16	(44)	(28)	2	1	1	2	(27)
2023	17	(45)	(28)	2	1	1	2	(28)
2024	17	(46)	(29)	2	1	1	2	(28)
2025	17	(47)	(30)	2	1	1	2	(29)
2026	18	(48)	(30)	2	1	1	2	(30)
2027	18	(49)	(31)	3	1	1	2	(30)
2028	18	(49)	(31)	3	1	1	2	(31)
2029	18	(50)	(32)	3	1	1	2	(32)
2030	19	(51)	(33)	3	1	1	2	(32)
2031	19	(52)	(33)	3	1	1	2	(33)
2032	19	(53)	(34)	3	1	1	2	(33)
2033	19	(54)	(34)	3	2	1	2	(34)
2034	20	(55)	(35)	3	2	1	2	(35)
2035	20	(56)	(36)	3	2	0	2	(35)
2036	20	(57)	(36)	3	2	0	2	(36)
2037	21	(57)	(37)	3	2	0	2	(36)
2038	21	(58)	(37)	3	2	0	2	(37)
2039	21	(59)	(38)	3	2	0	2	(37)
2040	21	(60)	(39)	3	2	0	2	(38)

2. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Watauga Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Watauga's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Watauga's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Watauga's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Watauga with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	77	45	121	1	2	3	118
2016	76	45	121	2	3	4	117
2017	76	45	121	2	3	5	116
2018	76	45	121	2	4	6	115
2019	76	45	121	3	4	7	114
2020	75	46	121	3	5	8	113
2021	75	46	121	4	5	8	113
2022	75	46	120	4	5	8	112
2023	75	46	120	4	5	9	112
2024	74	46	120	4	5	9	111
2025	74	46	120	5	5	9	110
2026	74	46	119	5	5	10	110
2027	74	46	119	5	5	10	109
2028	73	46	119	6	5	10	109
2029	73	46	119	6	5	10	108
2030	73	46	118	6	5	11	108
2031	73	46	118	6	4	11	108
2032	72	46	118	7	4	10	108
2033	72	46	118	7	3	10	108
2034	72	46	118	7	3	10	108
2035	72	46	117	7	2	10	108
2036	71	46	117	8	2	10	108
2037	71	46	117	8	1	9	107
2038	71	46	117	8	1	9	107
2039	71	46	116	9	0	9	107
2040	71	46	116	9	0	9	107
2041	70	46	116	9	0	9	107
2042	70	46	116	9	0	9	107
2043	70	46	116	10	0	10	106
2044	70	46	116	10	0	10	106
2045	70	46	116	10	0	10	105
2046	70	46	115	10	0	10	105
2047	70	46	115	11	0	11	105
2048	70	46	115	11	0	11	104
2049	69	46	115	11	0	11	104
2050	69	46	115	11	0	11	104
2051	69	46	115	12	0	12	103
2052	69	46	115	12	0	12	103
2053	69	46	115	12	0	12	103
2054	69	46	115	13	0	13	102
2055	69	46	115	13	0	13	102
2056	69	46	115	13	0	13	102
2057	69	46	115	13	0	13	101
2058	69	46	115	14	0	14	101
2059	69	46	115	14	0	14	101
2060	69	46	115	14	0	14	100
2061	69	46	115	15	0	15	100
2062	69	46	115	15	0	15	100
2063	69	46	115	15	0	15	99
2064	69	46	115	16	0	16	99
2065	69	46	115	16	0	16	99
2066	69	46	115	16	0	16	99
2067	69	46	115	16	0	16	98
2068	69	46	115	17	0	17	98
2069	69	46	115	17	0	17	98
2070	69	46	115	17	0	17	97

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Watauga's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	106	0	0	0
1	2015	24,525	105	7	121	114
2	2016	24,620	104	14	121	107
3	2017	24,715	104	22	121	100
4	2018	24,810	103	29	121	92
5-year Goal	2019	24,905	102	36	121	85
6	2020	25,000	101	47	121	73
7	2021	25,000	100	58	121	62
8	2022	25,000	98	69	120	51
9	2023	25,000	97	80	120	40
10-year Goal	2024	25,000	96	91	120	29

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Watauga's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	11.00	0	0	0
1	2015	24,525	10.80	2	45	43
2	2016	24,620	10.60	4	45	41
3	2017	24,715	10.40	5	45	40
4	2018	24,810	10.20	7	45	38
5-year Goal	2019	24,905	10.00	9	45	36
6	2020	25,000	10.00	9	46	37
7	2021	25,000	10.00	9	46	37
8	2022	25,000	10.00	9	46	37
9	2023	25,000	10.00	9	46	37
10-year Goal	2024	25,000	10.00	9	46	37

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 45 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	TOTAL SAVINGS
2012	77	77
2013	77	77
2014	77	77
2015	77	77
2016	76	76
2017	76	76
2018	76	76
2019	76	76
2020	75	75
2021	75	75
2022	75	75
2023	75	75
2024	74	74
2025	74	74
2026	74	74
2027	74	74
2028	73	73
2029	73	73
2030	73	73
2031	73	73
2032	72	72
2033	72	72
2034	72	72
2035	72	72
2036	71	71
2037	71	71
2038	71	71
2039	71	71
2040	71	71
2041	70	70
2042	70	70
2043	70	70
2044	70	70
2045	70	70
2046	70	70
2047	70	70
2048	70	70
2049	69	69
2050	69	69
2051	69	69
2052	69	69
2053	69	69
2054	69	69
2055	69	69
2056	69	69
2057	69	69
2058	69	69
2059	69	69
2060	69	69
2061	69	69
2062	69	69
2063	69	69
2064	69	69
2065	69	69
2066	69	69
2067	69	69
2068	69	69
2069	69	69
2070	69	69

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	11.00	0
2015	24,525	6.00	45
2016	24,620	6.00	45
2017	24,715	6.00	45
2018	24,810	6.00	45
2019	24,905	6.00	45
2020	25,000	6.00	46
2021	25,000	6.00	46
2022	25,000	6.00	46
2023	25,000	6.00	46
2024	25,000	6.00	46

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	76	45	121	13	2	3	4	130
2017	76	45	121	13	2	3	5	129
2018	76	45	121	13	2	4	6	128
2019	76	45	121	13	3	4	7	127
2020	75	46	121	13	3	5	8	126
2021	75	46	121	13	4	5	8	125
2022	75	46	120	13	4	5	8	125
2023	75	46	120	12	4	5	9	124
2024	74	46	120	12	4	5	9	123
2025	74	46	120	12	5	5	9	123
2026	74	46	119	12	5	5	10	122
2027	74	46	119	12	5	5	10	122
2028	73	46	119	12	6	5	10	121
2029	73	46	119	12	6	5	10	120
2030	73	46	118	12	6	5	11	120
2031	73	46	118	12	6	4	11	120
2032	72	46	118	12	7	4	10	120
2033	72	46	118	12	7	3	10	120
2034	72	46	118	12	7	3	10	120
2035	72	46	117	12	7	2	10	120
2036	71	46	117	12	8	2	10	120
2037	71	46	117	12	8	1	9	119
2038	71	46	117	12	8	1	9	119
2039	71	46	116	12	9	0	9	119
2040	71	46	116	12	9	0	9	119

2. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 19 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	76	45	121	19	2	3	4	136
2017	76	45	121	19	2	3	5	135
2018	76	45	121	19	2	4	6	134
2019	76	45	121	19	3	4	7	133
2020	75	46	121	19	3	5	8	132
2021	75	46	121	19	4	5	8	131
2022	75	46	120	19	4	5	8	131
2023	75	46	120	19	4	5	9	130
2024	74	46	120	19	4	5	9	130
2025	74	46	120	19	5	5	9	129
2026	74	46	119	18	5	5	10	128
2027	74	46	119	18	5	5	10	128
2028	73	46	119	18	6	5	10	127
2029	73	46	119	18	6	5	10	127
2030	73	46	118	18	6	5	11	126
2031	73	46	118	18	6	4	11	126
2032	72	46	118	18	7	4	10	126
2033	72	46	118	18	7	3	10	126
2034	72	46	118	18	7	3	10	126
2035	72	46	117	18	7	2	10	125
2036	71	46	117	18	8	2	10	125
2037	71	46	117	18	8	1	9	125
2038	71	46	117	18	8	1	9	125
2039	71	46	116	18	9	0	9	125
2040	71	46	116	18	9	0	9	125

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Weatherford Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Weatherford's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Weatherford's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Weatherford's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Weatherford with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	121	157	279	10	8	18	261
2016	125	159	284	13	9	22	262
2017	127	161	288	13	11	24	264
2018	130	162	292	15	13	29	263
2019	132	164	296	18	15	33	263
2020	134	165	299	23	17	40	259
2021	136	169	305	25	19	44	261
2022	139	172	310	27	21	48	262
2023	141	175	316	29	23	53	263
2024	143	178	321	31	25	57	265
2025	145	182	327	33	27	61	266
2026	148	185	332	35	29	65	268
2027	150	188	338	38	32	69	269
2028	152	191	344	40	34	73	270
2029	154	195	349	42	36	77	272
2030	157	198	355	44	38	81	273
2031	159	202	361	46	67	113	248
2032	162	205	367	49	96	145	222
2033	164	209	373	52	125	177	197
2034	167	213	380	55	154	208	171
2035	170	216	386	57	183	240	146
2036	172	220	392	60	212	272	121
2037	175	224	399	63	241	303	95
2038	178	228	405	66	270	335	70
2039	180	231	411	68	299	367	44
2040	183	235	418	71	328	399	19
2041	194	250	444	77	300	377	67
2042	205	265	470	82	273	355	114
2043	216	279	495	88	246	334	162
2044	227	294	521	94	219	312	209
2045	238	309	547	99	191	291	257
2046	249	324	573	105	164	269	304
2047	260	339	599	111	137	248	351
2048	272	354	625	116	110	226	399
2049	283	368	651	122	83	205	446
2050	294	383	677	128	55	183	494
2051	310	405	715	137	59	195	520
2052	327	427	754	146	62	207	547
2053	343	449	792	155	65	219	573
2054	360	471	831	164	68	232	599
2055	376	493	869	173	71	244	626
2056	393	515	908	182	74	256	652
2057	409	537	946	190	77	268	678
2058	426	558	984	199	80	280	705
2059	443	580	1,023	208	84	292	731
2060	459	602	1,061	217	87	304	757
2061	480	630	1,110	231	91	321	789
2062	501	658	1,159	244	95	339	820
2063	522	686	1,208	258	99	356	851
2064	543	713	1,256	271	103	374	883
2065	564	741	1,305	284	107	391	914
2066	585	769	1,354	298	111	408	945
2067	606	797	1,402	311	115	426	977
2068	627	824	1,451	325	119	443	1,008
2069	648	852	1,500	338	123	461	1,039
2070	669	880	1,549	351	127	478	1,071

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Weatherford's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	173	0	0	0
1	2015	28,742	171	19	279	260
2	2016	29,030	169	38	284	246
3	2017	29,319	168	58	288	230
4	2018	29,607	166	78	292	214
5-year Goal	2019	29,896	164	98	296	197
6	2020	30,184	163	108	299	191
7	2021	30,781	162	119	305	186
8	2022	31,379	162	131	310	180
9	2023	31,976	161	142	316	174
10-year Goal	2024	32,573	160	155	321	167

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Weatherford's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	33.00	0	0	0
1	2015	28,742	30.80	23	157	134
2	2016	29,030	28.60	47	159	112
3	2017	29,319	26.40	71	161	90
4	2018	29,607	24.20	95	162	67
5-year Goal	2019	29,896	22.00	120	164	44
6	2020	30,184	21.80	123	165	42
7	2021	30,781	21.60	128	169	40
8	2022	31,379	21.40	133	172	39
9	2023	31,976	21.20	138	175	37
10-year Goal	2024	32,573	21.00	143	178	36

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 157 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.58% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. **HE Toilet Replacement Program (MF)**
    a. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    b. Savings carry on indefinitely because replacement toilet will be as efficient

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	HE Toilets (SF)	HE Toilets (MF)	TOTAL SAVINGS
2012				0
2013				0
2014				0
2015	120	1.0	0.5	121
2016	122	2.1	1.0	125
2017	124	2.1	1.0	127
2018	127	2.1	1.0	130
2019	129	2.1	1.0	132
2020	131	2.1	1.0	134
2021	133	2.1	1.0	136
2022	136	2.1	1.0	139
2023	138	2.1	1.0	141
2024	140	2.1	1.0	143
2025	142	2.1	1.0	145
2026	145	2.1	1.0	148
2027	147	2.1	1.0	150
2028	149	2.1	1.0	152
2029	151	2.1	1.0	154
2030	153	2.1	1.0	157
2031	156	2.1	1.0	159
2032	159	2.1	1.0	162
2033	161	2.1	1.0	164
2034	164	2.1	1.0	167
2035	167	2.1	1.0	170
2036	169	2.1	1.0	172
2037	172	2.1	1.0	175
2038	174	2.1	1.0	178
2039	177	2.1	1.0	180
2040	180	2.1	1.0	183
2041	191	2.1	1.0	194
2042	202	2.1	1.0	205
2043	213	2.1	1.0	216
2044	224	2.1	1.0	227
2045	235	2.1	1.0	238
2046	246	2.1	1.0	249
2047	257	2.1	1.0	260
2048	269	2.1	1.0	272
2049	280	2.1	1.0	283
2050	291	2.1	1.0	294
2051	307	2.1	1.0	310
2052	324	2.1	1.0	327
2053	340	2.1	1.0	343
2054	357	2.1	1.0	360
2055	373	2.1	1.0	376
2056	390	2.1	1.0	393
2057	406	2.1	1.0	409
2058	423	2.1	1.0	426
2059	439	2.1	1.0	443
2060	456	2.1	1.0	459
2061	477	2.1	1.0	480
2062	498	2.1	1.0	501
2063	519	2.1	1.0	522
2064	540	2.1	1.0	543
2065	561	2.1	1.0	564
2066	582	2.1	1.0	585
2067	603	2.1	1.0	606
2068	624	2.1	1.0	627
2069	645	2.1	1.0	648
2070	666	2.1	1.0	669

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	33.00	0
2015	28,742	18.00	157
2016	29,030	18.00	159
2017	29,319	18.00	161
2018	29,607	18.00	162
2019	29,896	18.00	164
2020	30,184	18.00	165
2021	30,781	18.00	169
2022	31,379	18.00	172
2023	31,976	18.00	175
2024	32,573	18.00	178

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	125	159	284	22	13	9	22	283
2017	127	161	288	22	13	11	24	286
2018	130	162	292	22	15	13	29	286
2019	132	164	296	23	18	15	33	285
2020	134	165	299	23	23	17	40	283
2021	136	169	305	24	25	19	44	284
2022	139	172	310	24	27	21	48	286
2023	141	175	316	24	29	23	53	288
2024	143	178	321	25	31	25	57	290
2025	145	182	327	25	33	27	61	291
2026	148	185	332	26	35	29	65	293
2027	150	188	338	26	38	32	69	295
2028	152	191	344	26	40	34	73	297
2029	154	195	349	27	42	36	77	298
2030	157	198	355	27	44	38	81	300
2031	159	202	361	28	46	67	113	275
2032	162	205	367	28	49	96	145	250
2033	164	209	373	29	52	125	177	225
2034	167	213	380	29	55	154	208	200
2035	170	216	386	29	57	183	240	176
2036	172	220	392	30	60	212	272	151
2037	175	224	399	30	63	241	303	126
2038	178	228	405	31	66	270	335	101
2039	180	231	411	31	68	299	367	76
2040	183	235	418	32	71	328	399	51

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 32 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	125	159	284	32	13	9	22	294
2017	127	161	288	33	13	11	24	297
2018	130	162	292	33	15	13	29	297
2019	132	164	296	34	18	15	33	297
2020	134	165	299	35	23	17	40	294
2021	136	169	305	35	25	19	44	296
2022	139	172	310	36	27	21	48	298
2023	141	175	316	36	29	23	53	300
2024	143	178	321	37	31	25	57	302
2025	145	182	327	38	33	27	61	304
2026	148	185	332	38	35	29	65	306
2027	150	188	338	39	38	32	69	308
2028	152	191	344	39	40	34	73	310
2029	154	195	349	40	42	36	77	312
2030	157	198	355	40	44	38	81	314
2031	159	202	361	41	46	67	113	289
2032	162	205	367	42	49	96	145	264
2033	164	209	373	43	52	125	177	239
2034	167	213	380	43	55	154	208	215
2035	170	216	386	44	57	183	240	190
2036	172	220	392	45	60	212	272	165
2037	175	224	399	45	63	241	303	141
2038	178	228	405	46	66	270	335	116
2039	180	231	411	47	68	299	367	91
2040	183	235	418	47	71	328	399	67

3. Rain Barrels
   a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Weatherford Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Weatherford's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Weatherford's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Weatherford's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Weatherford with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	121	157	279	10	8	18	261
2016	125	159	284	13	9	22	262
2017	127	161	288	13	11	24	264
2018	130	162	292	15	13	29	263
2019	132	164	296	18	15	33	263
2020	134	165	299	23	17	40	259
2021	136	169	305	25	19	44	261
2022	139	172	310	27	21	48	262
2023	141	175	316	29	23	53	263
2024	143	178	321	31	25	57	265
2025	145	182	327	33	27	61	266
2026	148	185	332	35	29	65	268
2027	150	188	338	38	32	69	269
2028	152	191	344	40	34	73	270
2029	154	195	349	42	36	77	272
2030	157	198	355	44	38	81	273
2031	159	202	361	46	67	113	248
2032	162	205	367	49	96	145	222
2033	164	209	373	52	125	177	197
2034	167	213	380	55	154	208	171
2035	170	216	386	57	183	240	146
2036	172	220	392	60	212	272	121
2037	175	224	399	63	241	303	95
2038	178	228	405	66	270	335	70
2039	180	231	411	68	299	367	44
2040	183	235	418	71	328	399	19
2041	194	250	444	77	300	377	67
2042	205	265	470	82	273	355	114
2043	216	279	495	88	246	334	162
2044	227	294	521	94	219	312	209
2045	238	309	547	99	191	291	257
2046	249	324	573	105	164	269	304
2047	260	339	599	111	137	248	351
2048	272	354	625	116	110	226	399
2049	283	368	651	122	83	205	446
2050	294	383	677	128	55	183	494
2051	310	405	715	137	59	195	520
2052	327	427	754	146	62	207	547
2053	343	449	792	155	65	219	573
2054	360	471	831	164	68	232	599
2055	376	493	869	173	71	244	626
2056	393	515	908	182	74	256	652
2057	409	537	946	190	77	268	678
2058	426	558	984	199	80	280	705
2059	443	580	1,023	208	84	292	731
2060	459	602	1,061	217	87	304	757
2061	480	630	1,110	231	91	321	789
2062	501	658	1,159	244	95	339	820
2063	522	686	1,208	258	99	356	851
2064	543	713	1,256	271	103	374	883
2065	564	741	1,305	284	107	391	914
2066	585	769	1,354	298	111	408	945
2067	606	797	1,402	311	115	426	977
2068	627	824	1,451	325	119	443	1,008
2069	648	852	1,500	338	123	461	1,039
2070	669	880	1,549	351	127	478	1,071

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Weatherford's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	173	0	0	0
1	2015	28,742	171	19	279	260
2	2016	29,030	169	38	284	246
3	2017	29,319	168	58	288	230
4	2018	29,607	166	78	292	214
5-year Goal	2019	29,896	164	98	296	197
6	2020	30,184	163	108	299	191
7	2021	30,781	162	119	305	186
8	2022	31,379	162	131	310	180
9	2023	31,976	161	142	316	174
10-year Goal	2024	32,573	160	155	321	167

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Weatherford's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	33.00	0	0	0
1	2015	28,742	30.80	23	157	134
2	2016	29,030	28.60	47	159	112
3	2017	29,319	26.40	71	161	90
4	2018	29,607	24.20	95	162	67
5-year Goal	2019	29,896	22.00	120	164	44
6	2020	30,184	21.80	123	165	42
7	2021	30,781	21.60	128	169	40
8	2022	31,379	21.40	133	172	39
9	2023	31,976	21.20	138	175	37
10-year Goal	2024	32,573	21.00	143	178	36

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 157 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.58% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. **HE Toilet Replacement Program (MF)**
    a. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    b. Savings carry on indefinitely because replacement toilet will be as efficient

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	HE Toilets (SF)	HE Toilets (MF)	TOTAL SAVINGS
2012				0
2013				0
2014				0
2015	120	1.0	0.5	121
2016	122	2.1	1.0	125
2017	124	2.1	1.0	127
2018	127	2.1	1.0	130
2019	129	2.1	1.0	132
2020	131	2.1	1.0	134
2021	133	2.1	1.0	136
2022	136	2.1	1.0	139
2023	138	2.1	1.0	141
2024	140	2.1	1.0	143
2025	142	2.1	1.0	145
2026	145	2.1	1.0	148
2027	147	2.1	1.0	150
2028	149	2.1	1.0	152
2029	151	2.1	1.0	154
2030	153	2.1	1.0	157
2031	156	2.1	1.0	159
2032	159	2.1	1.0	162
2033	161	2.1	1.0	164
2034	164	2.1	1.0	167
2035	167	2.1	1.0	170
2036	169	2.1	1.0	172
2037	172	2.1	1.0	175
2038	174	2.1	1.0	178
2039	177	2.1	1.0	180
2040	180	2.1	1.0	183
2041	191	2.1	1.0	194
2042	202	2.1	1.0	205
2043	213	2.1	1.0	216
2044	224	2.1	1.0	227
2045	235	2.1	1.0	238
2046	246	2.1	1.0	249
2047	257	2.1	1.0	260
2048	269	2.1	1.0	272
2049	280	2.1	1.0	283
2050	291	2.1	1.0	294
2051	307	2.1	1.0	310
2052	324	2.1	1.0	327
2053	340	2.1	1.0	343
2054	357	2.1	1.0	360
2055	373	2.1	1.0	376
2056	390	2.1	1.0	393
2057	406	2.1	1.0	409
2058	423	2.1	1.0	426
2059	439	2.1	1.0	443
2060	456	2.1	1.0	459
2061	477	2.1	1.0	480
2062	498	2.1	1.0	501
2063	519	2.1	1.0	522
2064	540	2.1	1.0	543
2065	561	2.1	1.0	564
2066	582	2.1	1.0	585
2067	603	2.1	1.0	606
2068	624	2.1	1.0	627
2069	645	2.1	1.0	648
2070	666	2.1	1.0	669

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	33.00	0
2015	28,742	18.00	157
2016	29,030	18.00	159
2017	29,319	18.00	161
2018	29,607	18.00	162
2019	29,896	18.00	164
2020	30,184	18.00	165
2021	30,781	18.00	169
2022	31,379	18.00	172
2023	31,976	18.00	175
2024	32,573	18.00	178

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	125	159	284	22	13	9	22	283
2017	127	161	288	22	13	11	24	286
2018	130	162	292	22	15	13	29	286
2019	132	164	296	23	18	15	33	285
2020	134	165	299	23	23	17	40	283
2021	136	169	305	24	25	19	44	284
2022	139	172	310	24	27	21	48	286
2023	141	175	316	24	29	23	53	288
2024	143	178	321	25	31	25	57	290
2025	145	182	327	25	33	27	61	291
2026	148	185	332	26	35	29	65	293
2027	150	188	338	26	38	32	69	295
2028	152	191	344	26	40	34	73	297
2029	154	195	349	27	42	36	77	298
2030	157	198	355	27	44	38	81	300
2031	159	202	361	28	46	67	113	275
2032	162	205	367	28	49	96	145	250
2033	164	209	373	29	52	125	177	225
2034	167	213	380	29	55	154	208	200
2035	170	216	386	29	57	183	240	176
2036	172	220	392	30	60	212	272	151
2037	175	224	399	30	63	241	303	126
2038	178	228	405	31	66	270	335	101
2039	180	231	411	31	68	299	367	76
2040	183	235	418	32	71	328	399	51

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 32 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	125	159	284	32	13	9	22	294
2017	127	161	288	33	13	11	24	297
2018	130	162	292	33	15	13	29	297
2019	132	164	296	34	18	15	33	297
2020	134	165	299	35	23	17	40	294
2021	136	169	305	35	25	19	44	296
2022	139	172	310	36	27	21	48	298
2023	141	175	316	36	29	23	53	300
2024	143	178	321	37	31	25	57	302
2025	145	182	327	38	33	27	61	304
2026	148	185	332	38	35	29	65	306
2027	150	188	338	39	38	32	69	308
2028	152	191	344	39	40	34	73	310
2029	154	195	349	40	42	36	77	312
2030	157	198	355	40	44	38	81	314
2031	159	202	361	41	46	67	113	289
2032	162	205	367	42	49	96	145	264
2033	164	209	373	43	52	125	177	239
2034	167	213	380	43	55	154	208	215
2035	170	216	386	44	57	183	240	190
2036	172	220	392	45	60	212	272	165
2037	175	224	399	45	63	241	303	141
2038	178	228	405	46	66	270	335	116
2039	180	231	411	47	68	299	367	91
2040	183	235	418	47	71	328	399	67

3. Rain Barrels
    a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Wortham Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Wortham's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Wortham's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Wortham's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Wortham with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.1	0.4	0.5	0	0	0	0.5
2016	0.1	0.4	0.5	0	0	0	0.5
2017	0.1	0.5	0.6	0	0	0	0.6
2018	0.1	0.5	0.6	0	0	0	0.6
2019	0.1	0.5	0.6	0	0	0	0.6
2020	0.1	0.5	0.7	0	0	0	0.7
2021	0.1	0.6	0.7	0	0	0	0.7
2022	0.1	0.6	0.7	0	0.0	0	0.7
2023	0.1	0.6	0.7	0	0.1	0.1	0.6
2024	0.1	0.6	0.7	0	0.1	0.1	0.6
2025	0.1	0.6	0.7	0	0.1	0.1	0.6
2026	0.1	0.6	0.7	0	0.2	0.2	0.6
2027	0.1	0.6	0.7	0	0.2	0.2	0.5
2028	0.1	0.6	0.7	0	0.2	0.2	0.5
2029	0.1	0.6	0.7	0	0.3	0.3	0.5
2030	0.1	0.6	0.8	0	0.3	0.3	0.4
2031	0.1	0.6	0.8	0.1	0.3	0.4	0.3
2032	0.1	0.7	0.8	0.2	0.3	0.5	0.2
2033	0.1	0.7	0.8	0.3	0.3	0.6	0.2
2034	0.1	0.7	0.8	0.4	0.3	0.7	0.1
2035	0.1	0.7	0.8	0.5	0.3	0.8	(0.0)
2036	0.1	0.7	0.8	0.6	0.3	0.9	(0.1)
2037	0.1	0.7	0.8	0.7	0.3	1.0	(0.2)
2038	0.1	0.7	0.8	0.8	0.3	1.1	(0.3)
2039	0.1	0.7	0.8	0.9	0.3	1.2	(0.4)
2040	0.1	0.7	0.8	1.0	0.3	1.3	(0.5)
2041	0.1	0.7	0.9	1.0	0.3	1.3	(0.5)
2042	0.1	0.7	0.9	1.0	0.3	1.3	(0.5)
2043	0.1	0.8	0.9	1.0	0.3	1.3	(0.5)
2044	0.1	0.8	0.9	1.0	0.3	1.3	(0.45)
2045	0.1	0.8	0.9	1.0	0.3	1.3	(0.44)
2046	0.1	0.8	0.9	1.0	0.3	1.3	(0.43)
2047	0.1	0.8	0.9	1.0	0.3	1.3	(0.43)
2048	0.1	0.8	0.9	1.0	0.3	1.3	(0.42)
2049	0.1	0.8	0.9	1.0	0.3	1.3	0.00
2050	0.1	0.8	0.9	1.0	0.3	1.3	0.00
2051	0.1	0.8	0.9	1.1	0.3	1.4	(0.5)
2052	0.1	0.8	1.0	1.2	0.3	1.5	(0.6)
2053	0.1	0.8	1.0	1.3	0.3	1.6	(0.7)
2054	0.2	0.8	1.0	1.4	0.3	1.7	(0.7)
2055	0.2	0.8	1.0	1.5	0.3	1.8	(0.8)
2056	0.2	0.8	1.0	1.6	0.3	1.9	(0.9)
2057	0.2	0.9	1.0	1.7	0.3	2.0	(1.0)
2058	0.2	0.9	1.0	1.8	0.3	2.1	(1.1)
2059	0.2	0.9	1.1	1.9	0.3	2.2	(1.2)
2060	0.2	0.9	1.1	2.0	0.3	2.3	(1.3)
2061	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2062	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2063	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2064	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2065	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2066	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2067	0.2	0.9	1.1	2.0	0.3	2.3	(1.2)
2068	0.2	0.9	1.2	2.0	0.3	2.3	(1.2)
2069	0.2	0.9	1.2	2.0	0.3	2.3	(1.2)
2070	0.2	0.9	1.2	2.0	0.3	2.3	(1.2)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Wortham's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	91	0	0	0
1	2014	1,070	90	0	0.1	0
2	2015	1,069	89	1	0.5	0
3	2016	1,155	89	1	0.5	0
4	2017	1,241	88	1	0.6	(1)
5-year Goal	2018	1,328	87	2	0.6	(1)
6	2019	1,414	86	2	0.6	(2)
7	2020	1,500	86	3	0.7	(2)
8	2021	1,525	85	3	0.7	(3)
9	2022	1,550	85	4	0.7	(3)
10-year Goal	2023	1,575	84	4	0.7	(3)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Wortham's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	22.00	0	0	0
1	2014	1,070	20.20	0.7	0	0
2	2015	1,069	18.40	1.4	0.4	(1.0)
3	2016	1,155	16.60	2.3	0.4	(1.9)
4	2017	1,241	14.80	3.3	0.5	(2.8)
5-year Goal	2018	1,328	13.00	4.4	0.5	(3.9)
6	2019	1,414	13.00	4.6	0.5	(4.1)
7	2020	1,500	13.00	4.9	0.5	(4.4)
8	2021	1,525	13.00	5.0	0.6	(4.5)
9	2022	1,550	13.00	5.1	0.6	(4.5)
10-year Goal	2023	1,575	13.00	5.2	0.6	(4.6)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of .4 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase[16]
        i. 1.0% increase in 2014
    b. Estimated customer demand reduction of .2%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	0.11	0.1
2015	0.11	0.1
2016	0.11	0.1
2017	0.11	0.1
2018	0.11	0.1
2019	0.11	0.1
2020	0.11	0.1
2021	0.11	0.1
2022	0.11	0.1
2023	0.11	0.1
2024	0.11	0.1
2025	0.11	0.1
2026	0.11	0.1
2027	0.11	0.1
2028	0.11	0.1
2029	0.11	0.1
2030	0.11	0.1
2031	0.11	0.1
2032	0.11	0.1
2033	0.11	0.1
2034	0.12	0.1
2035	0.12	0.1
2036	0.12	0.1
2037	0.12	0.1
2038	0.12	0.1
2039	0.12	0.1
2040	0.12	0.1
2041	0.12	0.1
2042	0.12	0.1
2043	0.12	0.1
2044	0.12	0.1
2045	0.12	0.1
2046	0.12	0.1
2047	0.12	0.1
2048	0.12	0.1
2049	0.12	0.1
2050	0.12	0.1
2051	0.13	0.1
2052	0.13	0.1
2053	0.14	0.1
2054	0.15	0.2
2055	0.16	0.2
2056	0.17	0.2
2057	0.17	0.2
2058	0.18	0.2
2059	0.19	0.2
2060	0.20	0.2
2061	0.20	0.2
2062	0.20	0.2
2063	0.21	0.2
2064	0.21	0.2
2065	0.21	0.2
2066	0.21	0.2
2067	0.22	0.2
2068	0.22	0.2
2069	0.22	0.2
2070	0.22	0.2

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	22.00	0.0
2015	1,069	21.00	0.4
2016	1,155	21.00	0.4
2017	1,241	21.00	0.5
2018	1,328	21.00	0.5
2019	1,414	21.00	0.5
2020	1,500	21.00	0.5
2021	1,525	21.00	0.6
2022	1,550	21.00	0.6
2023	1,575	21.00	0.6
2024	1,600	21.00	0.6

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  - **a.** Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - i. Average Region C savings
    - ii. Specific percentage of outdoor usage unknown for your utility at this time
  - **b.** Savings could be 4 MG per year with current demand.
  - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	1	4	0	0	0	5
2017	0	0	1	4	0	0	0	5
2018	0	0	1	4	0	0	0	5
2019	0	1	1	4	0	0	0	5
2020	0	1	1	4	0	0	0	5
2021	0	1	1	4	0	0	0	5
2022	0	1	1	4	0	0	0	5
2023	0	1	1	4	0	0	0	5
2024	0	1	1	4	0	0	0	5
2025	0	1	1	4	0	0	0	5
2026	0	1	1	4	0	0	0	5
2027	0	1	1	5	0	0	0	5
2028	0	1	1	5	0	0	0	5
2029	0	1	1	5	0	0	0	5
2030	0	1	1	5	0	0	0	5
2031	0	1	1	5	0	0	0	5
2032	0	1	1	5	0	0	1	5
2033	0	1	1	5	0	0	1	5
2034	0	1	1	5	0	0	1	5
2035	0	1	1	5	1	0	1	5
2036	0	1	1	5	1	0	1	5
2037	0	1	1	5	1	0	1	4
2038	0	1	1	5	1	0	1	4
2039	0	1	1	5	1	0	1	4
2040	0	1	1	5	1	0	1	4

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	1	1	0	0	0	1
2017	0	0	1	1	0	0	0	1
2018	0	0	1	1	0	0	0	1
2019	0	1	1	1	0	0	0	1
2020	0	1	1	1	0	0	0	1
2021	0	1	1	1	0	0	0	1
2022	0	1	1	1	0	0	0	1
2023	0	1	1	1	0	0	0	1
2024	0	1	1	1	0	0	0	1
2025	0	1	1	1	0	0	0	1
2026	0	1	1	1	0	0	0	1
2027	0	1	1	1	0	0	0	1
2028	0	1	1	1	0	0	0	1
2029	0	1	1	1	0	0	0	1
2030	0	1	1	1	0	0	0	1
2031	0	1	1	1	0	0	0	1
2032	0	1	1	1	0	0	1	1
2033	0	1	1	1	0	0	1	1
2034	0	1	1	1	0	0	1	1
2035	0	1	1	1	1	0	1	1
2036	0	1	1	1	1	0	1	1
2037	0	1	1	1	1	0	1	1
2038	0	1	1	1	1	0	1	0
2039	0	1	1	1	1	0	1	0
2040	0	1	1	1	1	0	1	0

3. Rain Barrels

- **a.** In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Wylie Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

---

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Wylie's current water conservation activities and their quantified savings to two metrics: 1) Region C Water Plan's (Texas Water Development Board, 2016b) recommended WMS supply volumes for municipal conservation, and 2) Wylie's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Wylie's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Wylie with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with

---

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	208	68	277	3	5	9	268
2016	252	69	320	4	7	11	309
2017	254	69	324	4	8	12	311
2018	257	70	327	5	9	15	312
2019	260	70	330	6	11	17	313
2020	262	71	333	8	12	20	313
2021	265	72	337	9	12	21	316
2022	268	72	340	10	12	22	318
2023	270	73	344	11	12	23	321
2024	273	74	347	12	12	24	323
2025	276	75	351	13	12	25	326
2026	278	76	354	14	12	26	329
2027	281	77	358	15	12	27	331
2028	284	77	361	16	12	28	334
2029	287	78	365	17	12	29	336
2030	289	79	368	18	12	30	339
2031	291	80	371	19	11	29	341
2032	293	80	373	20	10	29	344
2033	295	81	375	21	8	29	346
2034	296	81	378	22	7	29	349
2035	298	82	380	23	6	29	351
2036	300	82	382	24	5	29	354
2037	302	83	385	25	4	29	356
2038	304	84	387	26	2	28	359
2039	305	84	389	27	1	28	361
2040	307	85	392	28	0	28	364
2041	309	85	394	29	0	29	365
2042	310	86	396	30	0	30	365
2043	311	86	397	31	0	31	366
2044	313	86	399	32	0	32	367
2045	314	87	401	33	0	33	368
2046	316	87	403	34	0	34	369
2047	317	88	405	36	0	36	369
2048	319	88	407	37	0	37	370
2049	320	89	409	38	0	38	371
2050	322	89	411	39	0	39	372
2051	323	89	412	40	0	40	372
2052	324	90	413	41	0	41	372
2053	325	90	414	42	0	42	372
2054	326	90	416	43	0	43	372
2055	327	91	417	44	0	44	373
2056	328	91	418	46	0	46	373
2057	329	91	420	47	0	47	373
2058	330	91	421	48	0	48	373
2059	330	92	422	49	0	49	373
2060	331	92	423	50	0	50	373
2061	333	92	425	51	0	51	373
2062	334	93	426	53	0	53	374
2063	335	93	427	54	0	54	374
2064	336	93	429	55	0	55	374
2065	337	93	430	56	0	56	374
2066	338	94	431	57	0	57	374
2067	339	94	433	58	0	58	374
2068	340	94	434	60	0	60	375
2069	341	95	435	61	0	61	375
2070	342	95	437	62	0	62	375

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Wylie's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	112	0	0	0
1	2015	46,708	112	0	277	277
2	2016	47,063	112	0	320	320
3	2017	47,418	112	0	324	324
4	2018	47,774	112	0	327	327
5-year Goal	2019	48,129	112	0	330	330
6	2020	48,484	112	0	333	333
7	2021	49,055	112	0	337	337
8	2022	49,627	112	0	340	340
9	2023	50,198	112	0	344	344
10-year Goal	2024	50,770	112	0	347	347

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Wylie's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	46,708	10.00	0	68	68
2	2016	47,063	10.00	0	69	69
3	2017	47,418	10.00	0	69	69
4	2018	47,774	10.00	0	70	70
5-year Goal	2019	48,129	10.00	0	70	70
6	2020	48,484	10.00	0	71	71
7	2021	49,055	10.00	0	72	72
8	2022	49,627	10.00	0	72	72
9	2023	50,198	10.00	0	73	73
10-year Goal	2024	50,770	10.00	0	74	74

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 68 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 4.0% increase in 2015
        ii. 9.0% increase in 2016
    b. Estimated customer demand reduction of 2.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 8.42% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increases	TOTAL SAVINGS
2009			0
2010	180		180
2011	182		182
2012	184		184
2013	186		186
2014	188		188
2015	190	18	208
2016	192	59	252
2017	194	60	254
2018	196	61	257
2019	198	61	260
2020	201	62	262
2021	203	63	265
2022	205	63	268
2023	207	64	270
2024	209	64	273
2025	211	65	276
2026	213	66	278
2027	215	66	281
2028	217	67	284
2029	219	68	287
2030	221	68	289
2031	222	69	291
2032	224	69	293
2033	225	69	295
2034	226	70	296
2035	228	70	298
2036	229	71	300
2037	231	71	302
2038	232	72	304
2039	233	72	305
2040	235	72	307
2041	236	73	309
2042	237	73	310
2043	238	73	311
2044	239	74	313
2045	240	74	314
2046	241	75	316
2047	242	75	317
2048	243	75	319
2049	245	76	320
2050	246	76	322
2051	246	76	323
2052	247	76	324
2053	248	77	325
2054	249	77	326
2055	249	77	327
2056	250	77	328
2057	251	78	329
2058	252	78	330
2059	253	78	330
2060	253	78	331
2061	254	78	333
2062	255	79	334
2063	256	79	335
2064	256	79	336
2065	257	79	337
2066	258	80	338
2067	259	80	339
2068	260	80	340
2069	260	80	341
2070	261	81	342

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	46,708	6.00	68
2016	47,063	6.00	69
2017	47,418	6.00	69
2018	47,774	6.00	70
2019	48,129	6.00	70
2020	48,484	6.00	71
2021	49,055	6.00	72
2022	49,627	6.00	72
2023	50,198	6.00	73
2024	50,770	6.00	74

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	252	69	320	31	4	7	11	340
2017	254	69	324	31	4	8	12	342
2018	257	70	327	31	5	9	15	344
2019	260	70	330	32	6	11	17	345
2020	262	71	333	32	8	12	20	345
2021	265	72	337	32	9	12	21	348
2022	268	72	340	33	10	12	22	351
2023	270	73	344	33	11	12	23	354
2024	273	74	347	33	12	12	24	357
2025	276	75	351	34	13	12	25	360
2026	278	76	354	34	14	12	26	362
2027	281	77	358	34	15	12	27	365
2028	284	77	361	35	16	12	28	368
2029	287	78	365	35	17	12	29	371
2030	289	79	368	35	18	12	30	374
2031	291	80	371	35	19	11	29	377
2032	293	80	373	36	20	10	29	379
2033	295	81	375	36	21	8	29	382
2034	296	81	378	36	22	7	29	385
2035	298	82	380	36	23	6	29	387
2036	300	82	382	36	24	5	29	390
2037	302	83	385	37	25	4	29	393
2038	304	84	387	37	26	2	28	396
2039	305	84	389	37	27	1	28	398
2040	307	85	392	37	28	0	28	401

2. Rain Barrels

a. In Region C, utilities could save approximately 20.9 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Region D Individual Reports

Statewide Water Conservation Quantification Project
City of Texarkana Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Texarkana's current water conservation activities and their quantified savings to two metrics: 1) Region D Water Plan's (Texas Water Development Board, 2016c) recommended WMS supply volumes for municipal conservation, and 2) Texarkana's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Texarkana's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Texarkana with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	103	369	472	927	0	927	(455)
2016	103	369	473	1,159	0	1,159	(686)
2017	104	370	473	1,159	0	1,159	(686)
2018	104	370	474	1,391	0	1,391	(917)
2019	104	371	474	1,623	0	1,623	(1,149)
2020	104	371	475	2,087	0	2,087	(1,612)
2021	104	372	476	2,095	0	2,095	(1,619)
2022	104	373	477	2,104	0	2,104	(1,626)
2023	105	374	479	2,112	0	2,112	(1,634)
2024	105	375	480	2,121	0	2,121	(1,641)
2025	105	376	481	2,129	0	2,129	(1,648)
2026	105	377	482	2,138	0	2,138	(1,655)
2027	105	378	483	2,146	0	2,146	(1,663)
2028	105	379	485	2,155	0	2,155	(1,670)
2029	105	380	486	2,163	0	2,163	(1,677)
2030	106	382	487	2,172	0	2,172	(1,685)
2031	106	382	487	2,177	0	2,177	(1,689)
2032	106	382	488	2,182	0	2,182	(1,694)
2033	106	382	488	2,187	0	2,187	(1,699)
2034	106	383	488	2,191	0	2,191	(1,703)
2035	106	383	489	2,196	0	2,196	(1,708)
2036	105	383	489	2,201	0	2,201	(1,712)
2037	105	384	489	2,206	0	2,206	(1,717)
2038	105	384	490	2,211	0	2,211	(1,722)
2039	105	384	490	2,216	0	2,216	(1,726)
2040	105	385	490	2,221	0	2,221	(1,731)
2041	105	385	490	2,219	0	2,219	(1,728)
2042	105	385	490	2,216	0	2,216	(1,726)
2043	105	385	490	2,214	0	2,214	(1,724)
2044	105	385	490	2,211	0	2,211	(1,722)
2045	105	385	490	2,209	0	2,209	(1,719)
2046	105	385	490	2,207	0	2,207	(1,717)
2047	105	385	490	2,204	0	2,204	(1,715)
2048	105	385	490	2,202	0	2,202	(1,712)
2049	105	385	490	2,200	0	2,200	(1,710)
2050	105	385	490	2,197	0	2,197	(1,708)
2051	105	385	490	2,197	0	2,197	(1,707)
2052	105	385	490	2,196	0	2,196	(1,707)
2053	105	385	490	2,196	0	2,196	(1,706)
2054	105	385	490	2,196	0	2,196	(1,706)
2055	105	385	490	2,195	0	2,195	(1,706)
2056	105	385	490	2,195	0	2,195	(1,705)
2057	105	385	490	2,194	0	2,194	(1,705)
2058	105	385	490	2,194	0	2,194	(1,704)
2059	105	385	490	2,193	0	2,193	(1,704)
2060	105	385	490	2,193	0	2,193	(1,703)
2061	105	385	490	2,193	0	2,193	(1,703)
2062	105	385	490	2,193	0	2,193	(1,703)
2063	105	385	490	2,193	0	2,193	(1,703)
2064	105	385	490	2,193	0	2,193	(1,703)
2065	105	385	490	2,193	0	2,193	(1,703)
2066	105	385	490	2,193	0	2,193	(1,703)
2067	105	385	490	2,193	0	2,193	(1,703)
2068	105	385	490	2,193	0	2,193	(1,703)
2069	105	385	490	2,193	0	2,193	(1,703)
2070	105	385	490	2,193	0	2,193	(1,703)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Texarkana's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	157	0	0	0
1	2015	37,442	156	11	420	409
2	2016	37,483	155	22	421	399
3	2017	37,524	155	33	421	388
4	2018	37,564	154	44	422	378
5-year Goal	2019	37,605	153	55	423	368
6	2020	37,646	152	63	423	360
7	2021	37,753	152	72	424	353
8	2022	37,859	151	80	426	346
9	2023	37,966	151	89	427	338
10-year Goal	2024	38,072	150	97	428	331

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Texarkana's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	41.00	0	0	0
1	2015	37,442	14.00	369	369	0
2	2016	37,483	14.00	369	369	0
3	2017	37,524	14.00	370	370	0
4	2018	37,564	14.00	370	370	0
5-year Goal	2019	37,605	14.00	371	371	0
6	2020	37,646	14.00	371	371	0
7	2021	37,753	14.00	372	372	0
8	2022	37,859	14.00	373	373	0
9	2023	37,966	14.00	374	374	0
10-year Goal	2024	38,072	14.00	375	375	0

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 369 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
        i. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	103.3	103.3
2016	103.4	103.4
2017	103.6	103.6
2018	103.7	103.7
2019	103.9	103.9
2020	104.1	104.1
2021	104.2	104.2
2022	104.4	104.4
2023	104.5	104.5
2024	104.7	104.7
2025	104.8	104.8
2026	105.0	105.0
2027	105.1	105.1
2028	105.3	105.3
2029	105.4	105.4
2030	105.6	105.6
2031	105.6	105.6
2032	105.6	105.6
2033	105.5	105.5
2034	105.5	105.5
2035	105.5	105.5
2036	105.5	105.5
2037	105.5	105.5
2038	105.4	105.4
2039	105.4	105.4
2040	105.4	105.4
2041	105.4	105.4
2042	105.3	105.3
2043	105.2	105.2
2044	105.2	105.2
2045	105.1	105.1
2046	105.1	105.1
2047	105.0	105.0
2048	104.9	104.9
2049	104.9	104.9
2050	104.8	104.8
2051	104.8	104.8
2052	104.8	104.8
2053	104.8	104.8
2054	104.8	104.8
2055	104.8	104.8
2056	104.8	104.8
2057	104.7	104.7
2058	104.7	104.7
2059	104.7	104.7
2060	104.7	104.7
2061	104.7	104.7
2062	104.7	104.7
2063	104.7	104.7
2064	104.7	104.7
2065	104.7	104.7
2066	104.7	104.7
2067	104.7	104.7
2068	104.7	104.7
2069	104.7	104.7
2070	104.7	104.7

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	41.00	0
2015	37,442	14.00	369
2016	37,483	14.00	369
2017	37,524	14.00	370
2018	37,564	14.00	370
2019	37,605	14.00	371
2020	37,646	14.00	371
2021	37,753	14.00	372
2022	37,859	14.00	373
2023	37,966	14.00	374
2024	38,072	14.00	375

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.37% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region D savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 305 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	103	369	473	305	1,159	0	1,159	(382)
2017	104	370	473	305	1,159	0	1,159	(381)
2018	104	370	474	306	1,391	0	1,391	(611)
2019	104	371	474	306	1,623	0	1,623	(842)
2020	104	371	475	307	2,087	0	2,087	(1,305)
2021	104	372	476	307	2,095	0	2,095	(1,312)
2022	104	373	477	308	2,104	0	2,104	(1,319)
2023	105	374	479	308	2,112	0	2,112	(1,325)
2024	105	375	480	309	2,121	0	2,121	(1,332)
2025	105	376	481	309	2,129	0	2,129	(1,339)
2026	105	377	482	309	2,138	0	2,138	(1,346)
2027	105	378	483	310	2,146	0	2,146	(1,353)
2028	105	379	485	310	2,155	0	2,155	(1,360)
2029	105	380	486	311	2,163	0	2,163	(1,367)
2030	106	382	487	311	2,172	0	2,172	(1,373)
2031	106	382	487	311	2,177	0	2,177	(1,378)
2032	106	382	488	311	2,182	0	2,182	(1,383)
2033	106	382	488	311	2,187	0	2,187	(1,387)
2034	106	383	488	311	2,191	0	2,191	(1,392)
2035	106	383	489	311	2,196	0	2,196	(1,397)
2036	105	383	489	311	2,201	0	2,201	(1,401)
2037	105	384	489	311	2,206	0	2,206	(1,406)
2038	105	384	490	311	2,211	0	2,211	(1,411)
2039	105	384	490	311	2,216	0	2,216	(1,415)
2040	105	385	490	311	2,221	0	2,221	(1,420)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[18]
g. See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	103	369	473	55	1,159	0	1,159	(631)
2017	104	370	473	56	1,159	0	1,159	(630)
2018	104	370	474	56	1,391	0	1,391	(862)
2019	104	371	474	56	1,623	0	1,623	(1,093)
2020	104	371	475	56	2,087	0	2,087	(1,556)
2021	104	372	476	56	2,095	0	2,095	(1,563)
2022	104	373	477	56	2,104	0	2,104	(1,570)
2023	105	374	479	56	2,112	0	2,112	(1,578)
2024	105	375	480	56	2,121	0	2,121	(1,585)
2025	105	376	481	56	2,129	0	2,129	(1,592)
2026	105	377	482	56	2,138	0	2,138	(1,599)
2027	105	378	483	56	2,146	0	2,146	(1,606)
2028	105	379	485	56	2,155	0	2,155	(1,614)
2029	105	380	486	57	2,163	0	2,163	(1,621)
2030	106	382	487	57	2,172	0	2,172	(1,628)
2031	106	382	487	57	2,177	0	2,177	(1,633)
2032	106	382	488	57	2,182	0	2,182	(1,637)
2033	106	382	488	57	2,187	0	2,187	(1,642)
2034	106	383	488	57	2,191	0	2,191	(1,647)
2035	106	383	489	57	2,196	0	2,196	(1,651)
2036	105	383	489	57	2,201	0	2,201	(1,656)
2037	105	384	489	57	2,206	0	2,206	(1,660)
2038	105	384	490	57	2,211	0	2,211	(1,665)
2039	105	384	490	57	2,216	0	2,216	(1,670)
2040	105	385	490	57	2,221	0	2,221	(1,674)

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 83 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	103	369	473	83	1,159	0	1,159	(604)
2017	104	370	473	83	1,159	0	1,159	(603)
2018	104	370	474	83	1,391	0	1,391	(834)
2019	104	371	474	83	1,623	0	1,623	(1,065)
2020	104	371	475	83	2,087	0	2,087	(1,528)
2021	104	372	476	83	2,095	0	2,095	(1,536)
2022	104	373	477	83	2,104	0	2,104	(1,543)
2023	105	374	479	84	2,112	0	2,112	(1,550)
2024	105	375	480	84	2,121	0	2,121	(1,557)
2025	105	376	481	84	2,129	0	2,129	(1,564)
2026	105	377	482	84	2,138	0	2,138	(1,572)
2027	105	378	483	84	2,146	0	2,146	(1,579)
2028	105	379	485	84	2,155	0	2,155	(1,586)
2029	105	380	486	84	2,163	0	2,163	(1,593)
2030	106	382	487	84	2,172	0	2,172	(1,600)
2031	106	382	487	84	2,177	0	2,177	(1,605)
2032	106	382	488	84	2,182	0	2,182	(1,609)
2033	106	382	488	84	2,187	0	2,187	(1,614)
2034	106	383	488	84	2,191	0	2,191	(1,619)
2035	106	383	489	84	2,196	0	2,196	(1,623)
2036	105	383	489	84	2,201	0	2,201	(1,628)
2037	105	384	489	84	2,206	0	2,206	(1,633)
2038	105	384	490	84	2,211	0	2,211	(1,637)
2039	105	384	490	84	2,216	0	2,216	(1,642)
2040	105	385	490	84	2,221	0	2,221	(1,646)

4. Rain Barrels
   a. In Region D, utilities could save approximately 25.3 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Region E Individual Reports

Statewide Water Conservation Quantification Project
Horizon Regional MUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Horizon Regional MUD's current water conservation activities and their quantified savings to two metrics: 1) Region E Water Plan's (Texas Water Development Board, 2016d) recommended WMS supply volumes for municipal conservation, and 2) Horizon Regional MUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Horizon Regional MUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Horizon Regional MUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	54	(156)	(102)	5	0	5	(108)
2016	57	(159)	(102)	7	0	7	(109)
2017	59	(161)	(102)	7	0	7	(109)
2018	62	(163)	(102)	8	0	8	(110)
2019	64	(166)	(102)	9	0	9	(111)
2020	67	(168)	(101)	12	0	12	(113)
2021	69	(170)	(101)	12	0	12	(113)
2022	71	(171)	(100)	13	0	13	(113)
2023	74	(173)	(99)	13	0	13	(112)
2024	76	(174)	(98)	14	0	14	(112)
2025	79	(176)	(97)	14	0	14	(111)
2026	81	(177)	(96)	15	0	15	(111)
2027	84	(179)	(95)	15	0	15	(110)
2028	86	(180)	(94)	15	0	15	(110)
2029	89	(182)	(93)	16	0	16	(109)
2030	91	(183)	(92)	16	0	16	(109)
2031	93	(185)	(92)	17	0	17	(109)
2032	96	(187)	(92)	17	0	17	(109)
2033	98	(189)	(91)	18	0	18	(109)
2034	100	(191)	(91)	18	0	18	(109)
2035	102	(193)	(91)	18	0	18	(109)
2036	105	(195)	(91)	19	0	19	(109)
2037	107	(197)	(90)	19	0	19	(110)
2038	109	(199)	(90)	20	0	20	(110)
2039	112	(201)	(90)	20	0	20	(110)
2040	114	(203)	(89)	21	0	21	(110)
2041	116	(207)	(91)	21	0	21	(112)
2042	119	(212)	(93)	21	0	21	(114)
2043	121	(216)	(95)	22	0	22	(117)
2044	123	(220)	(97)	22	0	22	(119)
2045	125	(224)	(99)	23	0	23	(121)
2046	128	(228)	(101)	23	0	23	(124)
2047	130	(232)	(102)	23	0	23	(126)
2048	132	(237)	(104)	24	0	24	(128)
2049	135	(241)	(106)	24	0	24	(130)
2050	137	(245)	(108)	25	0	25	(133)
2051	139	(249)	(110)	25	0	25	(135)
2052	141	(253)	(111)	26	0	26	(137)
2053	143	(257)	(113)	26	0	26	(139)
2054	146	(261)	(115)	26	0	26	(141)
2055	148	(264)	(117)	27	0	27	(143)
2056	150	(268)	(118)	27	0	27	(146)
2057	152	(272)	(120)	28	0	28	(148)
2058	154	(276)	(122)	28	0	28	(150)
2059	156	(280)	(124)	28	0	28	(152)
2060	159	(284)	(125)	29	0	29	(154)
2061	161	(288)	(127)	29	0	29	(156)
2062	163	(292)	(129)	29	0	29	(158)
2063	165	(295)	(130)	30	0	30	(160)
2064	167	(299)	(132)	30	0	30	(162)
2065	169	(303)	(134)	30	0	30	(164)
2066	171	(306)	(135)	31	0	31	(166)
2067	173	(310)	(137)	31	0	31	(168)
2068	175	(314)	(139)	32	0	32	(170)
2069	177	(317)	(140)	32	0	32	(172)
2070	179	(321)	(142)	32	0	32	(174)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Horizon Regional MUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	100	0	0	0
1	2009	29,524	99	11	0	(11)
2	2010	30,100	98	22	0	(22)
3	2011	30,676	97	34	0	(34)
4	2012	31,252	96	46	0	(46)
5-year Goal	2013	31,828	95	58	0	(58)
6	2014	32,404	94	71	52	(19)
7	2015	32,980	93	84	(102)	(186)
8	2016	33,464	92	98	(102)	(200)
9	2017	33,948	91	112	(102)	(213)
10-year Goal	2018	34,432	90	126	(102)	(227)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Horizon Regional MUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	9.00	0	0	0
1	2009	29,524	8.60	4	0	(4)
2	2010	30,100	8.20	9	0	(9)
3	2011	30,676	7.80	13	0	(13)
4	2012	31,252	7.40	18	0	(18)
5-year Goal	2013	31,828	7.00	23	0	(23)
6	2014	32,404	6.60	28	0	(28)
7	2015	32,980	6.20	34	(156)	(190)
8	2016	33,464	5.80	39	(159)	(198)
9	2017	33,948	5.40	45	(161)	(206)
10-year Goal	2018	34,432	5.00	50	(163)	(214)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 156 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Three times-a-week Outdoor Watering Restriction Ordinance**
    a. Approximate savings of 56 MG in 2016
    b. Estimated savings of 5.56% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. Based on El Paso's outdoor usage of 33%, which would yield approximately 6.95% savings of total demand under a two-times-per-week ordinance

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

1. Assumed that Horizon Regional MUD's customer base has similar outdoor usage patterns as that of El Paso

ii. Restricting outdoor watering to three times per week is estimated to yield 20% less savings than a two-times-per-week ordinance based on the effect that limiting watering to one time per week (which yields 20% more) has had for other utilities in this project.

iii. Savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	3x Watering Ordinance	TOTAL SAVINGS
2012		0
2013		0
2014	52	52
2015	54	54
2016	57	57
2017	59	59
2018	62	62
2019	64	64
2020	67	67
2021	69	69
2022	71	71
2023	74	74
2024	76	76
2025	79	79
2026	81	81
2027	84	84
2028	86	86
2029	89	89
2030	91	91
2031	93	93
2032	96	96
2033	98	98
2034	100	100
2035	102	102
2036	105	105
2037	107	107
2038	109	109
2039	112	112
2040	114	114
2041	116	116
2042	119	119
2043	121	121
2044	123	123
2045	125	125
2046	128	128
2047	130	130
2048	132	132
2049	135	135
2050	137	137
2051	139	139
2052	141	141
2053	143	143
2054	146	146
2055	148	148
2056	150	150
2057	152	152
2058	154	154
2059	156	156
2060	159	159
2061	161	161
2062	163	163
2063	165	165
2064	167	167
2065	169	169
2066	171	171
2067	173	173
2068	175	175
2069	177	177
2070	179	179

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	32,980	22.00	(156)
2016	33,464	22.00	(159)
2017	33,948	22.00	(161)
2018	34,432	22.00	(163)
2019	34,916	22.00	(166)
2020	35,400	22.00	(168)
2021	35,725	22.00	(170)
2022	36,050	22.00	(171)
2023	36,375	22.00	(173)
2024	36,700	22.00	(174)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	57	(159)	(102)	14	7	0	7	(95)
2017	59	(161)	(102)	14	7	0	7	(94)
2018	62	(163)	(102)	15	8	0	8	(95)
2019	64	(166)	(102)	15	9	0	9	(95)
2020	67	(168)	(101)	16	12	0	12	(97)
2021	69	(170)	(101)	17	12	0	12	(96)
2022	71	(171)	(100)	17	13	0	13	(95)
2023	74	(173)	(99)	18	13	0	13	(94)
2024	76	(174)	(98)	18	14	0	14	(93)
2025	79	(176)	(97)	19	14	0	14	(92)
2026	81	(177)	(96)	20	15	0	15	(91)
2027	84	(179)	(95)	20	15	0	15	(90)
2028	86	(180)	(94)	21	15	0	15	(89)
2029	89	(182)	(93)	21	16	0	16	(88)
2030	91	(183)	(92)	22	16	0	16	(87)
2031	93	(185)	(92)	22	17	0	17	(86)
2032	96	(187)	(92)	23	17	0	17	(86)
2033	98	(189)	(91)	24	18	0	18	(85)
2034	100	(191)	(91)	24	18	0	18	(85)
2035	102	(193)	(91)	25	18	0	18	(85)
2036	105	(195)	(91)	25	19	0	19	(84)
2037	107	(197)	(90)	26	19	0	19	(84)
2038	109	(199)	(90)	26	20	0	20	(83)
2039	112	(201)	(90)	27	20	0	20	(83)
2040	114	(203)	(89)	27	21	0	21	(82)

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 20 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	57	(159)	(102)	20	7	0	7	(88)
2017	59	(161)	(102)	21	7	0	7	(87)
2018	62	(163)	(102)	22	8	0	8	(88)
2019	64	(166)	(102)	23	9	0	9	(88)
2020	67	(168)	(101)	24	12	0	12	(90)
2021	69	(170)	(101)	25	12	0	12	(88)
2022	71	(171)	(100)	26	13	0	13	(87)
2023	74	(173)	(99)	27	13	0	13	(85)
2024	76	(174)	(98)	27	14	0	14	(84)
2025	79	(176)	(97)	28	14	0	14	(83)
2026	81	(177)	(96)	29	15	0	15	(81)
2027	84	(179)	(95)	30	15	0	15	(80)
2028	86	(180)	(94)	31	15	0	15	(79)
2029	89	(182)	(93)	32	16	0	16	(77)
2030	91	(183)	(92)	33	16	0	16	(76)
2031	93	(185)	(92)	34	17	0	17	(75)
2032	96	(187)	(92)	34	17	0	17	(75)
2033	98	(189)	(91)	35	18	0	18	(74)
2034	100	(191)	(91)	36	18	0	18	(73)
2035	102	(193)	(91)	37	18	0	18	(72)
2036	105	(195)	(91)	38	19	0	19	(72)
2037	107	(197)	(90)	39	19	0	19	(71)
2038	109	(199)	(90)	39	20	0	20	(70)
2039	112	(201)	(90)	40	20	0	20	(70)
2040	114	(203)	(89)	41	21	0	21	(69)

Statewide Water Conservation Quantification Project
City of El Paso Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares El Paso's current water conservation activities and their quantified savings to two metrics: 1) Region E Water Plan's (Texas Water Development Board, 2016d) recommended WMS supply volumes for municipal conservation, and 2) El Paso's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in El Paso's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for El Paso with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4,125	(249)	3,877	271	0	271	3,606
2016	5,408	(252)	5,156	339	0	339	4,817
2017	5,320	(256)	5,063	339	0	339	4,725
2018	5,346	(260)	5,086	406	0	406	4,680
2019	5,373	(264)	5,109	474	0	474	4,635
2020	5,399	(268)	5,131	609	0	609	4,522
2021	5,426	(271)	5,155	617	0	617	4,537
2022	5,462	(274)	5,187	625	0	625	4,562
2023	5,453	(278)	5,175	633	0	633	4,542
2024	5,444	(281)	5,163	641	0	641	4,522
2025	5,435	(284)	5,151	649	0	649	4,502
2026	5,426	(287)	5,138	656	0	656	4,482
2027	5,462	(291)	5,171	664	0	664	4,507
2028	5,497	(294)	5,204	672	0	672	4,532
2029	5,533	(297)	5,236	680	0	680	4,557
2030	5,569	(300)	5,269	688	0	688	4,581
2031	5,604	(303)	5,301	657	0	657	4,644
2032	5,639	(306)	5,332	626	0	626	4,707
2033	5,673	(309)	5,364	595	0	595	4,769
2034	5,708	(312)	5,396	564	0	564	4,832
2035	5,743	(315)	5,427	533	0	533	4,895
2036	5,777	(318)	5,459	502	0	502	4,957
2037	5,812	(321)	5,491	471	0	471	5,020
2038	5,847	(324)	5,522	440	0	440	5,082
2039	5,881	(327)	5,554	409	0	409	5,145
2040	5,916	(330)	5,586	378	0	378	5,208
2041	5,954	(333)	5,621	423	0	423	5,197
2042	5,992	(336)	5,656	469	0	469	5,187
2043	6,030	(339)	5,690	514	0	514	5,177
2044	6,068	(342)	5,725	559	0	559	5,166
2045	6,105	(345)	5,760	605	0	605	5,156
2046	6,143	(348)	5,795	650	0	650	5,145
2047	6,181	(351)	5,830	695	0	695	5,135
2048	6,219	(354)	5,865	740	0	740	5,124
2049	6,257	(357)	5,900	786	0	786	5,114
2050	6,295	(360)	5,935	831	0	831	5,104
2051	6,334	(363)	5,971	928	0	928	5,043
2052	6,373	(366)	6,007	1,025	0	1,025	4,982
2053	6,412	(369)	6,044	1,122	0	1,122	4,921
2054	6,452	(371)	6,080	1,220	0	1,220	4,861
2055	6,491	(374)	6,117	1,317	0	1,317	4,800
2056	6,530	(377)	6,153	1,414	0	1,414	4,739
2057	6,569	(380)	6,189	1,511	0	1,511	4,678
2058	6,608	(383)	6,226	1,608	0	1,608	4,618
2059	6,647	(385)	6,262	1,705	0	1,705	4,557
2060	6,687	(388)	6,298	1,802	0	1,802	4,496
2061	6,724	(391)	6,333	1,815	0	1,815	4,519
2062	6,762	(394)	6,368	1,827	0	1,827	4,541
2063	6,799	(396)	6,403	1,839	0	1,839	4,564
2064	6,837	(399)	6,438	1,852	0	1,852	4,586
2065	6,875	(401)	6,473	1,864	0	1,864	4,609
2066	6,912	(404)	6,508	1,877	0	1,877	4,632
2067	6,950	(407)	6,543	1,889	0	1,889	4,654
2068	6,987	(409)	6,578	1,901	0	1,901	4,677
2069	7,025	(412)	6,613	1,914	0	1,914	4,699
2070	7,063	(415)	6,648	1,926	0	1,926	4,722

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how El Paso's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the 5-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	133	0	0	0
1	2015	681,124	132	149	3,877	3,728
2	2016	691,705	132	303	5,156	4,853
3	2017	702,287	131	461	5,063	4,602
4	2018	712,868	131	624	5,086	4,462
5-year Goal	2019	723,450	130	792	5,109	4,317
6	2020	734,031	129	1,096	5,131	4,036
7	2021	742,890	128	1,405	5,155	3,750
8	2022	751,750	127	1,720	5,187	3,467
9	2023	760,609	126	2,043	5,175	3,132
10-year Goal	2024	769,469	125	2,373	5,163	2,790

13 In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how El Paso's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the 5-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2015	681,124	11.30	174	(249)	(423)
2	2016	691,705	10.60	353	(252)	(606)
3	2017	702,287	9.90	538	(256)	(795)
4	2018	712,868	9.20	729	(260)	(989)
5-year Goal	2019	723,450	8.50	924	(264)	(1,188)
6	2020	734,031	8.40	965	(268)	(1,232)
7	2021	742,890	8.30	1,003	(271)	(1,274)
8	2022	751,750	8.20	1,043	(274)	(1,317)
9	2023	760,609	8.10	1,083	(278)	(1,360)
10-year Goal	2024	769,469	8.00	1,123	(281)	(1,404)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 869 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Three times-a-week Outdoor Watering Restriction Ordinance**
    a. Approximate savings of 1,933 MG in 2016
    b. Estimated savings of 5.56% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Based on El Paso's outdoor usage of 33%, which would yield approximately 6.95% savings of total demand under a two-times-per-week ordinance
        ii. Restricting outdoor watering to three times per week is estimated to yield 20% less savings than a two-times-per-week ordinance based on the effect that limiting watering to one time per week (which yields 20% more) has had for other utilities in this project.
    c. Includes time of day restrictions
    d. Savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 11% increase in 2016
        ii. 7% increase in 2017

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.

b. Estimated customer demand reduction of 5.76%
c. Savings are cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
d. Derived from a price elasticity of –0.32 with respect to demand, rather than –0.20 average, due to independent rate study commissioned by the utility.
e. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

6. High Efficiency (HE) Toilet Replacement Program for Single Family (SF) Customers

a. 53,900 toilets replaced from 2003 to present (El Paso Water, 2017)
    i. Approximately 3,850 toilets replaced annually
b. Estimated savings of 10,390 gallons per year per toilet (A&N Technical Services, 2005)
c. Estimated total savings of 560 MG annually by program's end
d. Savings carry on indefinitely because replacement toilet will be as efficient due to plumbing code and efficiency standards

7. Showerhead Distribution (SF)

a. 220,000 showerheads replaced from 2003 to present (El Paso Water, 2017)
    i. Approximately 15,714 showerheads replaced annually
b. Estimated savings of 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
c. Estimated total savings of 451 MG annually by 2016
d. Savings carry on indefinitely because replacement showerheads will be as efficient due to plumbing code and efficiency standards

8. Clothes Washer Replacement Program (SF)

a. 17,023 washing machines replaced or installed during program lifetime (El Paso Water, 2017)
    i. Approximately 3,405 washing machines replaced annually
b. Estimated 7,030 gallons per year per washer (A&N Technical Services, 2005; THELMA, 1997)
c. Estimated total savings of 120 MG by program's end
d. Savings carry on indefinitely because replacement washers will be as efficient due to plumbing code and efficiency standards

9. Turf Rebate Program

a. 11,206,889 sq. ft. of landscape replaced with turf during life of program (El Paso Water, 2017)
b. Estimated total savings of 894 MG annually by program's end
c. Turf assumed to have 10-year useful life

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

10. Refrigeration Systems

a. 10,329 units introduced into service area during life of program (El Paso Water, 2017)
b. Approximately 2,582 introduced per year
c. Estimated savings of 17,427 gallons per year per system
d. Estimated total savings of 180 MG annually by program's end
e. Systems assumed to have 20-year useful life

11. Bleed-off Clamps for AC Units

a. 9,026 units introduced into service area during life of program (El Paso Water, 2017)
b. Approximately 1,805 units introduced per year
c. Estimated savings of 5,207 gallons per year per unit
d. Estimated total savings of 47 MG annually when fully implemented
e. Clamps assumed to have 5-year useful life

12. County-wide Conservation Efforts:

a. TecH2O Learning Center hosts schools from throughout the County (and sometimes beyond), provides teacher workshops for the region, and provides curriculum support and learning tools on water education to the whole area.
b. Many of the surrounding towns outside the City but within the County follow the City of El Paso Water Conservation Ordinance.
    i. Media campaigns for the Water Conservation ordinance (days of week and time of day watering) and the conservation publicity on tips to conserve goes well beyond City borders to include the Metropolitan Statistical Area MSA that reaches the whole County and beyond.
c. Landscaping, irrigation, and conservation workshops are open to the public and attract residents and businesses throughout the County.
    i. Giveaways of showerheads and air conditioner bleed-off clamps for AC units were distributed to water users across the county and beyond.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	3x Watering Ordinance	Water Rate Increases	Refrigeration Systems	Free Waterless Urinals Pilot Program	Cash for Commodes (SF)	Low Flow Showerheads (SF)	HE Clothes Washer Rebates (SF)	Turf Rebate	Air Condition Clamps (SF)	TOTAL SAVINGS
2009			180		560	225	120	894		1,980
2010			180		560	258	120	894		2,011
2011			180		560	290	120	894		2,044
2012	1,862		180		560	322	120	894	9.4	3,948
2013	1,880		180		560	354	120	894	18.8	4,007
2014	1,898		180		560	387	120	894	28.2	4,066
2015	1,915		180		560	419	120	894	37.6	4,125
2016	1,933	1,224	180		560	451	120	894	47.0	5,408
2017	1,951	2,021	180		560	451	120		37.6	5,320
2018	1,968	2,039	180		560	451	120		28.2	5,346
2019	1,986	2,057	180		560	451	120		18.8	5,373
2020	2,004	2,076	180		560	451	120		9.4	5,399
2021	2,021	2,094	180		560	451	120			5,426
2022	2,039	2,112	180		560	451	120			5,462
2023	2,057	2,131	135		560	451	120			5,453
2024	2,074	2,149	90		560	451	120			5,444
2025	2,092	2,167	45		560	451	120			5,435
2026	2,110	2,185			560	451	120			5,426
2027	2,127	2,204			560	451	120			5,462
2028	2,145	2,222			560	451	120			5,497
2029	2,162	2,240			560	451	120			5,533
2030	2,180	2,259			560	451	120			5,569
2031	2,197	2,276			560	451	120			5,604
2032	2,214	2,294			560	451	120			5,639
2033	2,231	2,311			560	451	120			5,673
2034	2,248	2,329			560	451	120			5,708
2035	2,265	2,347			560	451	120			5,743
2036	2,282	2,364			560	451	120			5,777
2037	2,299	2,382			560	451	120			5,812
2038	2,316	2,400			560	451	120			5,847
2039	2,333	2,417			560	451	120			5,881
2040	2,350	2,435			560	451	120			5,916
2041	2,369	2,454			560	451	120			5,954
2042	2,388	2,473			560	451	120			5,992
2043	2,406	2,493			560	451	120			6,030
2044	2,425	2,512			560	451	120			6,068
2045	2,443	2,531			560	451	120			6,105
2046	2,462	2,551			560	451	120			6,143
2047	2,481	2,570			560	451	120			6,181
2048	2,499	2,589			560	451	120			6,219
2049	2,518	2,608			560	451	120			6,257
2050	2,536	2,628			560	451	120			6,295
2051	2,556	2,648			560	451	120			6,334
2052	2,575	2,668			560	451	120			6,373
2053	2,594	2,687			560	451	120			6,412
2054	2,613	2,707			560	451	120			6,452
2055	2,633	2,727			560	451	120			6,491
2056	2,652	2,747			560	451	120			6,530
2057	2,671	2,767			560	451	120			6,569
2058	2,690	2,787			560	451	120			6,608
2059	2,710	2,807			560	451	120			6,647
2060	2,729	2,827			560	451	120			6,687
2061	2,747	2,846			560	451	120			6,724
2062	2,766	2,865			560	451	120			6,762
2063	2,784	2,884			560	451	120			6,799
2064	2,803	2,904			560	451	120			6,837
2065	2,821	2,923			560	451	120			6,875
2066	2,840	2,942			560	451	120			6,912
2067	2,858	2,961			560	451	120			6,950
2068	2,877	2,980			560	451	120			6,987
2069	2,895	2,999			560	451	120			7,025
2070	2,914	3,018			560	451	120			7,063

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	12.00	0
2015	681,124	12.00	0
2016	691,705	13.00	(252)
2017	702,287	13.00	(256)
2018	712,868	13.00	(260)
2019	723,450	13.00	(264)
2020	734,031	13.00	(268)
2021	742,890	13.00	(271)
2022	751,750	13.00	(274)
2023	760,609	13.00	(278)
2024	769,469	13.00	(281)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5,408	(252)	5,156	466	339	0	339	5,283
2017	5,320	(256)	5,063	470	339	0	339	5,195
2018	5,346	(260)	5,086	474	406	0	406	5,154
2019	5,373	(264)	5,109	479	474	0	474	5,113
2020	5,399	(268)	5,131	483	609	0	609	5,005
2021	5,426	(271)	5,155	487	617	0	617	5,025
2022	5,462	(274)	5,187	491	625	0	625	5,054
2023	5,453	(278)	5,175	496	633	0	633	5,038
2024	5,444	(281)	5,163	500	641	0	641	5,022
2025	5,435	(284)	5,151	504	649	0	649	5,006
2026	5,426	(287)	5,138	508	656	0	656	4,990
2027	5,462	(291)	5,171	513	664	0	664	5,019
2028	5,497	(294)	5,204	517	672	0	672	5,049
2029	5,533	(297)	5,236	521	680	0	680	5,078
2030	5,569	(300)	5,269	525	688	0	688	5,107
2031	5,604	(303)	5,301	530	657	0	657	5,174
2032	5,639	(306)	5,332	534	626	0	626	5,240
2033	5,673	(309)	5,364	538	595	0	595	5,307
2034	5,708	(312)	5,396	542	564	0	564	5,374
2035	5,743	(315)	5,427	546	533	0	533	5,441
2036	5,777	(318)	5,459	550	502	0	502	5,507
2037	5,812	(321)	5,491	554	471	0	471	5,574
2038	5,847	(324)	5,522	558	440	0	440	5,641
2039	5,881	(327)	5,554	562	409	0	409	5,707
2040	5,916	(330)	5,586	566	378	0	378	5,774

Region F Individual Reports

Statewide Water Conservation Quantification Project
City of Andrews Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Andrews's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Andrews's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Andrews's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Andrews with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(28)	(28)	12	0	12	(39)
2016	0	(29)	(29)	15	0	15	(44)
2017	0	(30)	(30)	15	0	15	(45)
2018	0	(31)	(31)	18	0	18	(49)
2019	0	(33)	(33)	21	0	21	(54)
2020	0	(34)	(34)	27	0	27	(60)
2021	0	(34)	(34)	27	0	27	(62)
2022	0	(35)	(35)	28	0	28	(63)
2023	0	(36)	(36)	28	0	28	(64)
2024	0	(36)	(36)	29	0	29	(65)
2025	0	(37)	(37)	29	0	29	(67)
2026	0	(38)	(38)	30	0	30	(68)
2027	0	(39)	(39)	31	0	31	(69)
2028	0	(39)	(39)	31	0	31	(70)
2029	0	(40)	(40)	32	0	32	(72)
2030	0	(41)	(41)	32	0	32	(73)
2031	0	(41)	(41)	33	0	33	(75)
2032	0	(42)	(42)	35	0	35	(77)
2033	0	(43)	(43)	36	0	36	(79)
2034	0	(43)	(43)	37	0	37	(80)
2035	0	(44)	(44)	38	0	38	(82)
2036	0	(45)	(45)	39	0	39	(84)
2037	0	(45)	(45)	41	0	41	(86)
2038	0	(46)	(46)	42	0	42	(88)
2039	0	(47)	(47)	43	0	43	(90)
2040	0	(47)	(47)	44	0	44	(92)
2041	0	(48)	(48)	45	0	45	(93)
2042	0	(49)	(49)	46	0	46	(94)
2043	0	(50)	(50)	46	0	46	(96)
2044	0	(50)	(50)	47	0	47	(97)
2045	0	(51)	(51)	48	0	48	(99)
2046	0	(52)	(52)	48	0	48	(100)
2047	0	(53)	(53)	49	0	49	(102)
2048	0	(53)	(53)	50	0	50	(103)
2049	0	(54)	(54)	50	0	50	(105)
2050	0	(55)	(55)	51	0	51	(106)
2051	0	(56)	(56)	52	0	52	(108)
2052	0	(57)	(57)	53	0	53	(110)
2053	0	(58)	(58)	54	0	54	(111)
2054	0	(58)	(58)	55	0	55	(113)
2055	0	(59)	(59)	55	0	55	(115)
2056	0	(60)	(60)	56	0	56	(116)
2057	0	(61)	(61)	57	0	57	(118)
2058	0	(62)	(62)	58	0	58	(120)
2059	0	(63)	(63)	59	0	59	(122)
2060	0	(64)	(64)	60	0	60	(123)
2061	0	(65)	(65)	61	0	61	(125)
2062	0	(66)	(66)	62	0	62	(127)
2063	0	(67)	(67)	63	0	63	(129)
2064	0	(68)	(68)	64	0	64	(131)
2065	0	(69)	(69)	65	0	65	(133)
2066	0	(70)	(70)	66	0	66	(135)
2067	0	(71)	(71)	66	0	66	(137)
2068	0	(72)	(72)	67	0	67	(139)
2069	0	(73)	(73)	68	0	68	(141)
2070	0	(73)	(73)	69	0	69	(142)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Andrews's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	11,825	223	0	0	0
1	2015	12,000	222	3	(28)	(30)
2	2016	12,593	222	6	(29)	(34)
3	2017	13,187	221	9	(30)	(39)
4	2018	13,780	221	12	(31)	(44)
5-year Goal	2019	14,374	220	16	(33)	(49)
6	2020	14,967	220	19	(34)	(52)
7	2021	15,298	219	21	(34)	(55)
8	2022	15,630	219	24	(35)	(59)
9	2023	15,961	218	27	(36)	(62)
10-year Goal	2024	16,293	218	30	(36)	(66)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Andrews's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	11,825	25.00	0	0	0
1	2015	12,000	24.00	4	(28)	(32)
2	2016	12,593	23.00	9	(29)	(38)
3	2017	13,187	22.00	14	(30)	(45)
4	2018	13,780	21.00	20	(31)	(52)
5-year Goal	2019	14,374	20.00	26	(33)	(59)
6	2020	14,967	19.60	29	(34)	(63)
7	2021	15,298	19.20	32	(34)	(67)
8	2022	15,630	18.80	35	(35)	(70)
9	2023	15,961	18.40	38	(36)	(74)
10-year Goal	2024	16,293	18.00	42	(36)	(78)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 28 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
        i. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline		25.00	0
2015	12,000	31.00	(28)
2016	12,593	31.00	(29)
2017	13,187	31.00	(30)
2018	13,780	31.00	(31)
2019	14,374	31.00	(33)
2020	14,967	31.00	(34)
2021	15,298	31.00	(34)
2022	15,630	31.00	(35)
2023	15,961	31.00	(36)
2024	16,293	31.00	(36)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(29)	(29)	17	15	0	15	(27)
2017	0	(30)	(30)	18	15	0	15	(28)
2018	0	(31)	(31)	18	18	0	18	(31)
2019	0	(33)	(33)	18	21	0	21	(35)
2020	0	(34)	(34)	19	27	0	27	(42)
2021	0	(34)	(34)	19	27	0	27	(42)
2022	0	(35)	(35)	19	28	0	28	(43)
2023	0	(36)	(36)	20	28	0	28	(44)
2024	0	(36)	(36)	20	29	0	29	(45)
2025	0	(37)	(37)	21	29	0	29	(46)
2026	0	(38)	(38)	21	30	0	30	(47)
2027	0	(39)	(39)	21	31	0	31	(48)
2028	0	(39)	(39)	22	31	0	31	(49)
2029	0	(40)	(40)	22	32	0	32	(50)
2030	0	(41)	(41)	22	32	0	32	(51)
2031	0	(41)	(41)	23	33	0	33	(52)
2032	0	(42)	(42)	23	35	0	35	(54)
2033	0	(43)	(43)	23	36	0	36	(55)
2034	0	(43)	(43)	24	37	0	37	(57)
2035	0	(44)	(44)	24	38	0	38	(58)
2036	0	(45)	(45)	24	39	0	39	(60)
2037	0	(45)	(45)	25	41	0	41	(61)
2038	0	(46)	(46)	25	42	0	42	(63)
2039	0	(47)	(47)	25	43	0	43	(64)
2040	0	(47)	(47)	26	44	0	44	(66)

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 26 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(29)	(29)	26	15	0	15	(18)
2017	0	(30)	(30)	26	15	0	15	(19)
2018	0	(31)	(31)	27	18	0	18	(23)
2019	0	(33)	(33)	27	21	0	21	(26)
2020	0	(34)	(34)	28	27	0	27	(32)
2021	0	(34)	(34)	28	27	0	27	(33)
2022	0	(35)	(35)	29	28	0	28	(34)
2023	0	(36)	(36)	30	28	0	28	(35)
2024	0	(36)	(36)	30	29	0	29	(35)
2025	0	(37)	(37)	31	29	0	29	(36)
2026	0	(38)	(38)	31	30	0	30	(37)
2027	0	(39)	(39)	32	31	0	31	(37)
2028	0	(39)	(39)	32	31	0	31	(38)
2029	0	(40)	(40)	33	32	0	32	(39)
2030	0	(41)	(41)	33	32	0	32	(40)
2031	0	(41)	(41)	34	33	0	33	(41)
2032	0	(42)	(42)	34	35	0	35	(42)
2033	0	(43)	(43)	35	36	0	36	(44)
2034	0	(43)	(43)	35	37	0	37	(45)
2035	0	(44)	(44)	36	38	0	38	(46)
2036	0	(45)	(45)	36	39	0	39	(48)
2037	0	(45)	(45)	37	41	0	41	(49)
2038	0	(46)	(46)	37	42	0	42	(50)
2039	0	(47)	(47)	38	43	0	43	(52)
2040	0	(47)	(47)	38	44	0	44	(53)

Statewide Water Conservation Quantification Project
City of Ballinger Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Ballinger's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Ballinger's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Ballinger's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8 9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Ballinger with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	0.2	0.2	8	0	8	(8)
2016	0	0.2	0.2	11	0	11	(10)
2017	0	0.2	0.2	11	0	11	(10)
2018	0	0.2	0.2	13	0	13	(12)
2019	0	0.2	0.2	15	0	15	(14)
2020	0	0.2	0.2	19	0	19	(19)
2021	0	0.2	0.2	19	0	19	(19)
2022	0	0.2	0.2	19	0	19	(19)
2023	0	0.2	0.2	19	0	19	(19)
2024	0	0.2	0.2	19	0	19	(19)
2025	0	0.2	0.2	19	0	19	(19)
2026	0	0.2	0.2	19	0	19	(19)
2027	0	0.2	0.2	19	0	19	(19)
2028	0	0.2	0.2	19	0	19	(19)
2029	0	0.2	0.2	19	0	19	(19)
2030	0	0.2	0.2	19	0	19	(19)
2031	0	0.2	0.2	19	0	19	(19)
2032	0	0.2	0.2	19	0	19	(19)
2033	0	0.2	0.2	19	0	19	(19)
2034	0	0.2	0.2	19	0	19	(19)
2035	0	0.2	0.2	19	0	19	(19)
2036	0	0.2	0.2	19	0	19	(19)
2037	0	0.2	0.2	19	0	19	(19)
2038	0	0.2	0.2	19	0	19	(19)
2039	0	0.2	0.2	19	0	19	(19)
2040	0	0.2	0.2	19	0	19	(19)
2041	0	0.2	0.2	19	0	19	(19)
2042	0	0.2	0.2	19	0	19	(19)
2043	0	0.2	0.2	19	0	19	(19)
2044	0	0.2	0.2	19	0	19	(19)
2045	0	0.2	0.2	19	0	19	(19)
2046	0	0.2	0.2	19	0	19	(19)
2047	0	0.2	0.2	19	0	19	(19)
2048	0	0.2	0.2	19	0	19	(19)
2049	0	0.2	0.2	19	0	19	(19)
2050	0	0.2	0.2	19	0	19	(19)
2051	0	0.2	0.2	19	0	19	(19)
2052	0	0.2	0.2	19	0	19	(19)
2053	0	0.2	0.2	19	0	19	(19)
2054	0	0.2	0.2	19	0	19	(19)
2055	0	0.2	0.2	19	0	19	(19)
2056	0	0.2	0.2	19	0	19	(19)
2057	0	0.2	0.2	19	0	19	(19)
2058	0	0.2	0.2	19	0	19	(19)
2059	0	0.2	0.2	19	0	19	(19)
2060	0	0.2	0.2	19	0	19	(19)
2061	0	0.2	0.2	19	0	19	(19)
2062	0	0.2	0.2	19	0	19	(19)
2063	0	0.2	0.2	19	0	19	(19)
2064	0	0.2	0.2	19	0	19	(19)
2065	0	0.2	0.2	19	0	19	(19)
2066	0	0.2	0.2	19	0	19	(19)
2067	0	0.2	0.2	19	0	19	(19)
2068	0	0.2	0.2	19	0	19	(19)
2069	0	0.2	0.2	19	0	19	(19)
2070	0	0.2	0.2	19	0	19	(19)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Ballinger's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	169	0	0	0
1	2015	3,767	168	2	0.2	(2)
2	2016	3,786	166	4	0.2	(4)
3	2017	3,806	165	6	0.2	(6)
4	2018	3,825	163	8	0.2	(8)
5-year Goal	2019	3,845	162	10	0.2	(10)
6	2020	3,864	161	11	0.2	(11)
7	2021	3,874	160	12	0.2	(12)
8	2022	3,884	160	13	0.2	(13)
9	2023	3,895	159	14	0.2	(14)
10-year Goal	2024	3,905	158	16	0.2	(15)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Ballinger's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2015	3,767	16.00	(3)	0.2	3
2	2016	3,786	18.00	(6)	0.2	6
3	2017	3,806	20.00	(8)	0.2	9
4	2018	3,825	22.00	(11)	0.2	11
5-year Goal	2019	3,845	24.00	(14)	0.2	14
6	2020	3,864	24.00	(14)	0.2	14
7	2021	3,874	24.00	(14)	0.2	14
8	2022	3,884	24.00	(14)	0.2	14
9	2023	3,895	24.00	(14)	0.2	14
10-year Goal	2024	3,905	24.00	(14)	0.2	14

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0.2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14.00	0
2015	3,767	13.85	0.2
2016	3,786	13.85	0.2
2017	3,806	13.85	0.2
2018	3,825	13.85	0.2
2019	3,845	13.85	0.2
2020	3,864	13.85	0.2
2021	3,874	13.85	0.2
2022	3,884	13.85	0.2
2023	3,895	13.85	0.2
2024	3,905	13.85	0.2

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	3	11	0	11	(7)
2017	0	0	0	3	11	0	11	(7)
2018	0	0	0	3	13	0	13	(9)
2019	0	0	0	3	15	0	15	(11)
2020	0	0	0	3	19	0	19	(16)
2021	0	0	0	3	19	0	19	(16)
2022	0	0	0	3	19	0	19	(16)
2023	0	0	0	3	19	0	19	(16)
2024	0	0	0	3	19	0	19	(16)
2025	0	0	0	3	19	0	19	(16)
2026	0	0	0	3	19	0	19	(16)
2027	0	0	0	3	19	0	19	(16)
2028	0	0	0	3	19	0	19	(16)
2029	0	0	0	3	19	0	19	(16)
2030	0	0	0	3	19	0	19	(16)
2031	0	0	0	3	19	0	19	(16)
2032	0	0	0	3	19	0	19	(16)
2033	0	0	0	3	19	0	19	(16)
2034	0	0	0	3	19	0	19	(16)
2035	0	0	0	3	19	0	19	(16)
2036	0	0	0	3	19	0	19	(16)
2037	0	0	0	3	19	0	19	(16)
2038	0	0	0	3	19	0	19	(16)
2039	0	0	0	3	19	0	19	(16)
2040	0	0	0	3	19	0	19	(16)

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 5 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	5	11	0	11	(6)
2017	0	0	0	5	11	0	11	(6)
2018	0	0	0	5	13	0	13	(8)
2019	0	0	0	4	15	0	15	(10)
2020	0	0	0	4	19	0	19	(14)
2021	0	0	0	4	19	0	19	(14)
2022	0	0	0	4	19	0	19	(14)
2023	0	0	0	4	19	0	19	(14)
2024	0	0	0	4	19	0	19	(14)
2025	0	0	0	4	19	0	19	(14)
2026	0	0	0	4	19	0	19	(14)
2027	0	0	0	4	19	0	19	(14)
2028	0	0	0	4	19	0	19	(14)
2029	0	0	0	4	19	0	19	(14)
2030	0	0	0	4	19	0	19	(15)
2031	0	0	0	4	19	0	19	(15)
2032	0	0	0	4	19	0	19	(14)
2033	0	0	0	4	19	0	19	(14)
2034	0	0	0	4	19	0	19	(14)
2035	0	0	0	4	19	0	19	(14)
2036	0	0	0	4	19	0	19	(14)
2037	0	0	0	4	19	0	19	(14)
2038	0	0	0	4	19	0	19	(14)
2039	0	0	0	4	19	0	19	(14)
2040	0	0	0	4	19	0	19	(14)

Statewide Water Conservation Quantification Project
City of Brady Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Brady's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Brady's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Brady's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Brady with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	5.4	(26)	(21)	5	0	5	(25)
2016	5.4	(26)	(21)	6	0	6	(26)
2017	5.4	(26)	(21)	6	0	6	(26)
2018	5.4	(26)	(21)	7	0	7	(28)
2019	5.4	(26)	(21)	8	0	8	(29)
2020	5.4	(26)	(21)	10	0	10	(31)
2021	5.4	(26)	(21)	10	0	10	(31)
2022	5.5	(26)	(21)	10	0	10	(31)
2023	5.5	(26)	(21)	11	0	11	(31)
2024	5.5	(26)	(21)	11	0	11	(31)
2025	5.5	(26)	(21)	11	0	11	(31)
2026	5.5	(26)	(21)	11	0	11	(31)
2027	5.5	(26)	(21)	11	0	11	(31)
2028	5.5	(26)	(21)	11	0	11	(31)
2029	5.5	(26)	(21)	11	0	11	(31)
2030	5.5	(26)	(21)	11	0	11	(32)
2031	5.5	(26)	(21)	11	0	11	(32)
2032	5.5	(26)	(21)	11	0	11	(32)
2033	5.5	(26)	(21)	11	0	11	(32)
2034	5.5	(26)	(21)	11	0	11	(32)
2035	5.5	(26)	(21)	11	0	11	(32)
2036	5.5	(26)	(21)	11	0	11	(32)
2037	5.5	(26)	(21)	11	0	11	(32)
2038	5.5	(26)	(21)	11	0	11	(32)
2039	5.5	(26)	(21)	11	0	11	(32)
2040	5.5	(26)	(21)	11	0	11	(32)
2041	5.5	(26)	(21)	11	0	11	(32)
2042	5.5	(26)	(21)	11	0	11	(32)
2043	5.5	(26)	(21)	11	0	11	(32)
2044	5.5	(27)	(21)	11	0	11	(32)
2045	5.5	(27)	(21)	11	0	11	(32)
2046	5.5	(27)	(21)	11	0	11	(32)
2047	5.5	(27)	(21)	11	0	11	(32)
2048	5.5	(27)	(21)	11	0	11	(32)
2049	5.5	(27)	(21)	11	0	11	(32)
2050	5.5	(27)	(21)	11	0	11	(32)
2051	5.5	(27)	(21)	11	0	11	(32)
2052	5.5	(27)	(21)	11	0	11	(32)
2053	5.5	(27)	(21)	11	0	11	(32)
2054	5.5	(27)	(21)	11	0	11	(32)
2055	5.5	(27)	(21)	11	0	11	(32)
2056	5.5	(27)	(21)	11	0	11	(32)
2057	5.5	(27)	(21)	11	0	11	(32)
2058	5.5	(27)	(21)	11	0	11	(32)
2059	5.5	(27)	(21)	11	0	11	(32)
2060	5.5	(27)	(21)	11	0	11	(32)
2061	5.5	(27)	(21)	11	0	11	(32)
2062	5.5	(27)	(21)	11	0	11	(32)
2063	5.5	(27)	(21)	11	0	11	(32)
2064	5.5	(27)	(21)	11	0	11	(32)
2065	5.5	(27)	(21)	11	0	11	(32)
2066	5.5	(27)	(21)	11	0	11	(32)
2067	5.5	(27)	(21)	11	0	11	(32)
2068	5.5	(27)	(21)	11	0	11	(32)
2069	5.5	(27)	(21)	11	0	11	(32)
2070	5.5	(27)	(21)	11	0	11	(32)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Brady's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	231	0	0	0
1	2015	5,946	228	6	(21)	(26)
2	2016	5,953	226	11	(21)	(32)
3	2017	5,960	223	17	(21)	(38)
4	2018	5,966	221	23	(21)	(43)
5-year Goal	2019	5,973	218	28	(21)	(49)
6	2020	5,980	217	31	(21)	(51)
7	2021	5,983	216	33	(21)	(54)
8	2022	5,985	215	35	(21)	(56)
9	2023	5,988	214	37	(21)	(58)
10-year Goal	2024	5,991	213	39	(21)	(60)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Brady's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	5,946	9.70	1	(26)	(27)
2	2016	5,953	9.40	1	(26)	(27)
3	2017	5,960	9.10	2	(26)	(28)
4	2018	5,966	8.80	3	(26)	(29)
5-year Goal	2019	5,973	8.50	3	(26)	(29)
6	2020	5,980	8.56	3	(26)	(29)
7	2021	5,983	8.62	3	(26)	(29)
8	2022	5,985	8.68	3	(26)	(29)
9	2023	5,988	8.74	3	(26)	(29)
10-year Goal	2024	5,991	8.80	3	(26)	(29)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 26 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3% increase in 2015
        ii. 3% increase in 2016
    b. Estimated customer demand reduction of 1.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	5.38	5.4
2016	5.39	5.4
2017	5.40	5.4
2018	5.41	5.4
2019	5.42	5.4
2020	5.43	5.4
2021	5.44	5.4
2022	5.45	5.5
2023	5.47	5.5
2024	5.48	5.5
2025	5.49	5.5
2026	5.50	5.5
2027	5.51	5.5
2028	5.52	5.5
2029	5.53	5.5
2030	5.55	5.5
2031	5.54	5.5
2032	5.53	5.5
2033	5.52	5.5
2034	5.52	5.5
2035	5.51	5.5
2036	5.50	5.5
2037	5.49	5.5
2038	5.49	5.5
2039	5.48	5.5
2040	5.47	5.5
2041	5.47	5.5
2042	5.48	5.5
2043	5.48	5.5
2044	5.49	5.5
2045	5.49	5.5
2046	5.49	5.5
2047	5.50	5.5
2048	5.50	5.5
2049	5.50	5.5
2050	5.51	5.5
2051	5.51	5.5
2052	5.51	5.5
2053	5.51	5.5
2054	5.51	5.5
2055	5.51	5.5
2056	5.51	5.5
2057	5.51	5.5
2058	5.51	5.5
2059	5.51	5.5
2060	5.51	5.5
2061	5.52	5.5
2062	5.52	5.5
2063	5.52	5.5
2064	5.52	5.5
2065	5.52	5.5
2066	5.52	5.5
2067	5.52	5.5
2068	5.52	5.5
2069	5.52	5.5
2070	5.52	5.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	10.00	0
2015	5,946	22.00	(26)
2016	5,953	22.00	(26)
2017	5,960	22.00	(26)
2018	5,966	22.00	(26)
2019	5,973	22.00	(26)
2020	5,980	22.00	(26)
2021	5,983	22.00	(26)
2022	5,985	22.00	(26)
2023	5,988	22.00	(26)
2024	5,991	22.00	(26)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region F savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 36 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	(26)	(21)	36	6	0	6	9
2017	5	(26)	(21)	36	6	0	6	9
2018	5	(26)	(21)	36	7	0	7	8
2019	5	(26)	(21)	36	8	0	8	7
2020	5	(26)	(21)	36	10	0	10	5
2021	5	(26)	(21)	36	10	0	10	5
2022	5	(26)	(21)	36	10	0	10	5
2023	5	(26)	(21)	36	11	0	11	5
2024	5	(26)	(21)	37	11	0	11	5
2025	5	(26)	(21)	37	11	0	11	5
2026	6	(26)	(21)	37	11	0	11	5
2027	6	(26)	(21)	37	11	0	11	5
2028	6	(26)	(21)	37	11	0	11	5
2029	6	(26)	(21)	37	11	0	11	5
2030	6	(26)	(21)	37	11	0	11	5
2031	6	(26)	(21)	37	11	0	11	5
2032	6	(26)	(21)	37	11	0	11	5
2033	6	(26)	(21)	37	11	0	11	5
2034	6	(26)	(21)	37	11	0	11	5
2035	6	(26)	(21)	37	11	0	11	5
2036	6	(26)	(21)	37	11	0	11	5
2037	5	(26)	(21)	37	11	0	11	5
2038	5	(26)	(21)	37	11	0	11	5
2039	5	(26)	(21)	37	11	0	11	5
2040	5	(26)	(21)	36	11	0	11	5

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	(26)	(21)	6	6	0	6	(20)
2017	5	(26)	(21)	6	6	0	6	(20)
2018	5	(26)	(21)	6	7	0	7	(22)
2019	5	(26)	(21)	6	8	0	8	(23)
2020	5	(26)	(21)	6	10	0	10	(25)
2021	5	(26)	(21)	6	10	0	10	(25)
2022	5	(26)	(21)	6	10	0	10	(25)
2023	5	(26)	(21)	6	11	0	11	(25)
2024	5	(26)	(21)	6	11	0	11	(25)
2025	5	(26)	(21)	6	11	0	11	(25)
2026	6	(26)	(21)	6	11	0	11	(25)
2027	6	(26)	(21)	6	11	0	11	(25)
2028	6	(26)	(21)	6	11	0	11	(25)
2029	6	(26)	(21)	6	11	0	11	(25)
2030	6	(26)	(21)	6	11	0	11	(25)
2031	6	(26)	(21)	6	11	0	11	(25)
2032	6	(26)	(21)	6	11	0	11	(25)
2033	6	(26)	(21)	6	11	0	11	(25)
2034	6	(26)	(21)	6	11	0	11	(25)
2035	6	(26)	(21)	6	11	0	11	(25)
2036	6	(26)	(21)	6	11	0	11	(25)
2037	5	(26)	(21)	6	11	0	11	(25)
2038	5	(26)	(21)	6	11	0	11	(26)
2039	5	(26)	(21)	6	11	0	11	(26)
2040	5	(26)	(21)	6	11	0	11	(26)

3. Rain Barrels
    a. In Region F, utilities could save approximately 11.2 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Coleman Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Coleman's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Coleman's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Coleman's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Coleman with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	7.5	22.3	30	4	0	4	26
2016	7.5	22.4	30	5	0	5	25
2017	7.5	22.6	30	5	0	5	25
2018	7.5	22.7	30	6	0	6	25
2019	7.5	22.8	30	7	0	7	24
2020	7.5	22.9	30	8	0	8	22
2021	7.5	22.9	30	9	0	9	22
2022	7.5	23.0	30	9	0	9	22
2023	7.5	23.0	31	9	0	9	22
2024	7.5	23.1	31	9	0	9	22
2025	7.5	23.1	31	9	0	9	22
2026	7.5	23.1	31	9	0	9	22
2027	7.5	23.2	31	9	0	9	22
2028	7.4	23.2	31	9	0	9	22
2029	7.4	23.3	31	9	0	9	22
2030	7.4	23.3	31	9	0	9	22
2031	7.4	23.4	31	9	0	9	22
2032	7.4	23.4	31	9	0	9	22
2033	7.4	23.4	31	9	0	9	22
2034	7.4	23.4	31	9	0	9	22
2035	7.4	23.4	31	9	0	9	22
2036	7.3	23.4	31	9	0	9	22
2037	7.3	23.4	31	9	0	9	22
2038	7.3	23.4	31	9	0	9	22
2039	7.3	23.4	31	9	0	9	22
2040	7.3	23.4	31	9	0	9	22
2041	7.3	23.4	31	9	0	9	22
2042	7.3	23.4	31	9	0	9	22
2043	7.3	23.4	31	9	0	9	22
2044	7.3	23.4	31	9	0	9	22
2045	7.3	23.4	31	9	0	9	22
2046	7.3	23.4	31	9	0	9	22
2047	7.3	23.4	31	9	0	9	22
2048	7.2	23.4	31	9	0	9	22
2049	7.2	23.4	31	9	0	9	22
2050	7.2	23.4	31	9	0	9	22
2051	7.2	23.4	31	9	0	9	22
2052	7.2	23.4	31	9	0	9	22
2053	7.2	23.4	31	9	0	9	22
2054	7.2	23.4	31	9	0	9	22
2055	7.2	23.4	31	9	0	9	22
2056	7.2	23.4	31	9	0	9	22
2057	7.2	23.4	31	9	0	9	22
2058	7.2	23.4	31	9	0	9	22
2059	7.2	23.4	31	9	0	9	22
2060	7.2	23.4	31	9	0	9	22
2061	7.2	23.4	31	9	0	9	22
2062	7.2	23.4	31	9	0	9	22
2063	7.2	23.4	31	9	0	9	22
2064	7.2	23.4	31	9	0	9	22
2065	7.2	23.4	31	9	0	9	22
2066	7.2	23.4	31	9	0	9	22
2067	7.2	23.4	31	9	0	9	22
2068	7.2	23.4	31	9	0	9	22
2069	7.2	23.4	31	9	0	9	22
2070	7.2	23.4	31	9	0	9	22

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Coleman's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	211	0	0	0
1	2015	4,709	205	11	30	19
2	2016	4,731	199	21	30	9
3	2017	4,753	192	32	30	(2)
4	2018	4,776	186	43	30	(13)
5-year Goal	2019	4,798	180	54	30	(24)
6	2020	4,820	176	62	30	(31)
7	2021	4,831	172	69	30	(38)
8	2022	4,842	168	76	30	(46)
9	2023	4,852	164	83	31	(53)
10-year Goal	2024	4,863	160	91	31	(60)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Coleman's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	58.00	0	0	0
1	2015	4,709	50.40	13	22.3	9
2	2016	4,731	42.80	26	22.4	(4)
3	2017	4,753	35.20	40	22.6	(17)
4	2018	4,776	27.60	53	22.7	(30)
5-year Goal	2019	4,798	20.00	67	22.8	(44)
6	2020	4,820	19.00	69	22.9	(46)
7	2021	4,831	18.00	71	22.9	(48)
8	2022	4,842	17.00	72	23.0	(49)
9	2023	4,852	16.00	74	23.0	(51)
10-year Goal	2024	4,863	15.00	76	23.1	(53)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 22.3 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 14% increase in 2014
    b. Estimated customer demand reduction of 2.8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012		0
2013		0
2014	7.54	7.5
2015	7.53	7.5
2016	7.53	7.5
2017	7.52	7.5
2018	7.51	7.5
2019	7.51	7.5
2020	7.50	7.5
2021	7.49	7.5
2022	7.49	7.5
2023	7.48	7.5
2024	7.48	7.5
2025	7.47	7.5
2026	7.46	7.5
2027	7.46	7.5
2028	7.45	7.4
2029	7.44	7.4
2030	7.44	7.4
2031	7.42	7.4
2032	7.40	7.4
2033	7.39	7.4
2034	7.37	7.4
2035	7.35	7.4
2036	7.33	7.3
2037	7.32	7.3
2038	7.30	7.3
2039	7.28	7.3
2040	7.26	7.3
2041	7.26	7.3
2042	7.26	7.3
2043	7.26	7.3
2044	7.26	7.3
2045	7.25	7.3
2046	7.25	7.3
2047	7.25	7.3
2048	7.25	7.2
2049	7.25	7.2
2050	7.25	7.2
2051	7.24	7.2
2052	7.24	7.2
2053	7.24	7.2
2054	7.24	7.2
2055	7.24	7.2
2056	7.23	7.2
2057	7.23	7.2
2058	7.23	7.2
2059	7.23	7.2
2060	7.23	7.2
2061	7.23	7.2
2062	7.23	7.2
2063	7.23	7.2
2064	7.23	7.2
2065	7.23	7.2
2066	7.23	7.2
2067	7.23	7.2
2068	7.23	7.2
2069	7.23	7.2
2070	7.23	7.2

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	58.00	0
2015	4,709	45.00	22
2016	4,731	45.00	22
2017	4,753	45.00	23
2018	4,776	45.00	23
2019	4,798	45.00	23
2020	4,820	45.00	23
2021	4,831	45.00	23
2022	4,842	45.00	23
2023	4,852	45.00	23
2024	4,863	45.00	23

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	8	22	30	4	5	0	5	29
2017	8	23	30	4	5	0	5	29
2018	8	23	30	4	6	0	6	28
2019	8	23	30	4	7	0	7	27
2020	8	23	30	4	8	0	8	25
2021	7	23	30	4	9	0	9	25
2022	7	23	30	4	9	0	9	26
2023	7	23	31	4	9	0	9	26
2024	7	23	31	4	9	0	9	26
2025	7	23	31	4	9	0	9	25
2026	7	23	31	4	9	0	9	25
2027	7	23	31	4	9	0	9	26
2028	7	23	31	4	9	0	9	26
2029	7	23	31	4	9	0	9	26
2030	7	23	31	4	9	0	9	26
2031	7	23	31	4	9	0	9	26
2032	7	23	31	4	9	0	9	26
2033	7	23	31	4	9	0	9	26
2034	7	23	31	4	9	0	9	25
2035	7	23	31	4	9	0	9	25
2036	7	23	31	4	9	0	9	25
2037	7	23	31	4	9	0	9	25
2038	7	23	31	3	9	0	9	25
2039	7	23	31	3	9	0	9	25
2040	7	23	31	3	9	0	9	25

Statewide Water Conservation Quantification Project
City of Junction Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Junction's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Junction's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Junction's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Junction with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	3.7	(6.6)	(3)	7	0	7	(9)
2016	3.7	(6.6)	(3)	8	0	8	(11)
2017	3.7	(6.6)	(3)	8	0	8	(11)
2018	3.7	(6.7)	(3)	10	0	10	(13)
2019	3.7	(6.7)	(3)	11	0	11	(14)
2020	3.7	(6.7)	(3)	15	0	15	(18)
2021	3.7	(6.7)	(3)	15	0	15	(18)
2022	3.7	(6.7)	(3)	15	0	15	(18)
2023	3.7	(6.7)	(3)	15	0	15	(18)
2024	3.7	(6.8)	(3)	15	0	15	(18)
2025	3.7	(6.8)	(3)	15	0	15	(18)
2026	3.7	(6.8)	(3)	15	0	15	(18)
2027	3.6	(6.8)	(3)	15	0	15	(18)
2028	3.6	(6.8)	(3)	15	0	15	(18)
2029	3.6	(6.8)	(3)	15	0	15	(18)
2030	3.6	(6.8)	(3)	15	0	15	(18)
2031	3.6	(6.8)	(3)	15	0	15	(18)
2032	3.6	(6.8)	(3)	15	0	15	(18)
2033	3.6	(6.8)	(3)	15	0	15	(18)
2034	3.6	(6.8)	(3)	15	0	15	(18)
2035	3.6	(6.8)	(3)	15	0	15	(18)
2036	3.6	(6.8)	(3)	15	0	15	(18)
2037	3.6	(6.8)	(3)	15	0	15	(18)
2038	3.6	(6.8)	(3)	15	0	15	(18)
2039	3.6	(6.8)	(3)	15	0	15	(18)
2040	3.6	(6.8)	(3)	15	0	15	(18)
2041	3.6	(6.8)	(3)	15	0	15	(18)
2042	3.6	(6.8)	(3)	15	0	15	(18)
2043	3.6	(6.8)	(3)	15	0	15	(18)
2044	3.6	(6.8)	(3)	15	0	15	(18)
2045	3.6	(6.8)	(3)	15	0	15	(18)
2046	3.6	(6.8)	(3)	15	0	15	(18)
2047	3.6	(6.8)	(3)	15	0	15	(18)
2048	3.6	(6.8)	(3)	15	0	15	(18)
2049	3.6	(6.8)	(3)	15	0	15	(18)
2050	3.5	(6.8)	(3)	15	0	15	(18)
2051	3.5	(6.8)	(3)	15	0	15	(18)
2052	3.5	(6.8)	(3)	15	0	15	(18)
2053	3.5	(6.8)	(3)	15	0	15	(18)
2054	3.5	(6.8)	(3)	15	0	15	(18)
2055	3.5	(6.8)	(3)	15	0	15	(18)
2056	3.5	(6.8)	(3)	15	0	15	(18)
2057	3.5	(6.8)	(3)	15	0	15	(18)
2058	3.5	(6.8)	(3)	15	0	15	(18)
2059	3.5	(6.8)	(3)	15	0	15	(18)
2060	3.5	(6.8)	(3)	15	0	15	(18)
2061	3.5	(6.8)	(3)	15	0	15	(18)
2062	3.5	(6.8)	(3)	15	0	15	(18)
2063	3.5	(6.8)	(3)	15	0	15	(18)
2064	3.5	(6.8)	(3)	15	0	15	(18)
2065	3.5	(6.8)	(3)	15	0	15	(18)
2066	3.5	(6.8)	(3)	15	0	15	(18)
2067	3.5	(6.8)	(3)	15	0	15	(18)
2068	3.5	(6.8)	(3)	15	0	15	(18)
2069	3.5	(6.8)	(3)	15	0	15	(18)
2070	3.5	(6.8)	(3)	15	0	15	(18)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Junction's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	190	0	0	0
1	2015	2,574	188	2	(3)	(5)
2	2016	2,586	186	3	(3)	(6)
3	2017	2,597	185	5	(3)	(8)
4	2018	2,609	183	7	(3)	(10)
5-year Goal	2019	2,620	181	9	(3)	(12)
6	2020	2,632	179	11	(3)	(14)
7	2021	2,635	177	13	(3)	(16)
8	2022	2,637	175	14	(3)	(18)
9	2023	2,640	173	16	(3)	(19)
10-year Goal	2024	2,642	171	18	(3)	(21)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Junction's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	30.00	0	0	0
1	2015	2,574	29.80	0	(6.6)	(7)
2	2016	2,586	29.60	0	(6.6)	(7)
3	2017	2,597	29.40	1	(6.6)	(7)
4	2018	2,609	29.20	1	(6.7)	(7)
5-year Goal	2019	2,620	29.00	1	(6.7)	(8)
6	2020	2,632	28.60	1	(6.7)	(8)
7	2021	2,635	28.20	2	(6.7)	(8)
8	2022	2,637	27.80	2	(6.7)	(9)
9	2023	2,640	27.40	3	(6.7)	(9)
10-year Goal	2024	2,642	27.00	3	(6.8)	(10)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 7 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 8% increase in 2015
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	3.70	3.7
2016	3.69	3.7
2017	3.69	3.7
2018	3.69	3.7
2019	3.68	3.7
2020	3.68	3.7
2021	3.67	3.7
2022	3.67	3.7
2023	3.67	3.7
2024	3.66	3.7
2025	3.66	3.7
2026	3.65	3.7
2027	3.65	3.6
2028	3.65	3.6
2029	3.64	3.6
2030	3.64	3.6
2031	3.63	3.6
2032	3.63	3.6
2033	3.62	3.6
2034	3.61	3.6
2035	3.61	3.6
2036	3.60	3.6
2037	3.60	3.6
2038	3.59	3.6
2039	3.58	3.6
2040	3.58	3.6
2041	3.58	3.6
2042	3.57	3.6
2043	3.57	3.6
2044	3.57	3.6
2045	3.56	3.6
2046	3.56	3.6
2047	3.56	3.6
2048	3.55	3.6
2049	3.55	3.6
2050	3.55	3.5
2051	3.55	3.5
2052	3.55	3.5
2053	3.55	3.5
2054	3.55	3.5
2055	3.55	3.5
2056	3.55	3.5
2057	3.54	3.5
2058	3.54	3.5
2059	3.54	3.5
2060	3.54	3.5
2061	3.54	3.5
2062	3.54	3.5
2063	3.54	3.5
2064	3.54	3.5
2065	3.54	3.5
2066	3.54	3.5
2067	3.54	3.5
2068	3.54	3.5
2069	3.54	3.5
2070	3.54	3.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	30.00	0
2015	2,574	37.00	(7)
2016	2,586	37.00	(7)
2017	2,597	37.00	(7)
2018	2,609	37.00	(7)
2019	2,620	37.00	(7)
2020	2,632	37.00	(7)
2021	2,635	37.00	(7)
2022	2,637	37.00	(7)
2023	2,640	37.00	(7)
2024	2,642	37.00	(7)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4	(7)	(3)	3	8	0	8	(8)
2017	4	(7)	(3)	3	8	0	8	(8)
2018	4	(7)	(3)	3	10	0	10	(10)
2019	4	(7)	(3)	3	11	0	11	(12)
2020	4	(7)	(3)	3	15	0	15	(15)
2021	4	(7)	(3)	3	15	0	15	(15)
2022	4	(7)	(3)	3	15	0	15	(15)
2023	4	(7)	(3)	3	15	0	15	(15)
2024	4	(7)	(3)	3	15	0	15	(15)
2025	4	(7)	(3)	3	15	0	15	(15)
2026	4	(7)	(3)	3	15	0	15	(15)
2027	4	(7)	(3)	3	15	0	15	(15)
2028	4	(7)	(3)	3	15	0	15	(15)
2029	4	(7)	(3)	3	15	0	15	(15)
2030	4	(7)	(3)	3	15	0	15	(15)
2031	4	(7)	(3)	3	15	0	15	(15)
2032	4	(7)	(3)	3	15	0	15	(15)
2033	4	(7)	(3)	3	15	0	15	(15)
2034	4	(7)	(3)	3	15	0	15	(15)
2035	4	(7)	(3)	3	15	0	15	(15)
2036	4	(7)	(3)	3	15	0	15	(15)
2037	4	(7)	(3)	3	15	0	15	(16)
2038	4	(7)	(3)	3	15	0	15	(16)
2039	4	(7)	(3)	3	15	0	15	(16)
2040	4	(7)	(3)	3	15	0	15	(16)

Statewide Water Conservation Quantification Project
City of Midland Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Midland's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Midland's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Midland's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Midland with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	311	49	360	118	0	118	242
2016	313	48	361	147	0	147	214
2017	315	48	363	147	0	147	216
2018	317	48	364	177	0	177	188
2019	318	48	366	206	0	206	160
2020	320	48	367	265	0	265	103
2021	322	48	369	267	0	267	102
2022	323	48	372	269	0	269	102
2023	325	49	374	271	0	271	102
2024	327	49	376	274	0	274	102
2025	328	49	378	276	0	276	102
2026	330	50	380	278	0	278	102
2027	332	50	382	280	0	280	102
2028	334	50	384	282	0	282	102
2029	335	51	386	284	0	284	101
2030	337	51	388	286	0	286	101
2031	340	51	391	290	0	290	102
2032	343	52	395	293	0	293	102
2033	346	52	398	296	0	296	103
2034	349	53	402	299	0	299	103
2035	352	53	405	302	0	302	103
2036	355	54	409	305	0	305	104
2037	358	55	412	308	0	308	104
2038	361	55	416	311	0	311	105
2039	364	56	419	314	0	314	105
2040	367	56	423	317	0	317	106
2041	370	57	426	320	0	320	106
2042	373	57	430	323	0	323	107
2043	376	58	434	326	0	326	108
2044	379	58	438	329	0	329	109
2045	383	59	441	332	0	332	110
2046	386	59	445	335	0	335	110
2047	389	60	449	337	0	337	111
2048	392	60	452	340	0	340	112
2049	395	61	456	343	0	343	113
2050	398	61	460	346	0	346	114
2051	402	62	463	349	0	349	114
2052	405	62	467	352	0	352	115
2053	408	63	471	355	0	355	116
2054	412	63	475	358	0	358	117
2055	415	64	479	360	0	360	118
2056	418	64	482	363	0	363	119
2057	421	65	486	366	0	366	120
2058	425	65	490	369	0	369	121
2059	428	66	494	372	0	372	122
2060	431	66	498	375	0	375	123
2061	435	67	501	378	0	378	124
2062	438	67	505	380	0	380	125
2063	441	68	509	383	0	383	126
2064	444	68	513	386	0	386	127
2065	448	69	516	389	0	389	128
2066	451	69	520	392	0	392	129
2067	454	70	524	394	0	394	130
2068	457	70	528	397	0	397	131
2069	461	71	532	400	0	400	131
2070	464	71	535	403	0	403	132

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Midland's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	186	0	0	0
1	2016	132,413	185	58	361	303
2	2017	131,877	184	116	363	247
3	2018	131,340	182	173	364	191
4	2019	130,804	181	230	366	136
5-year Goal	2020	130,267	180	286	367	81
6	2021	131,182	179	333	369	37
7	2022	132,097	178	383	372	(12)
8	2023	133,012	177	434	374	(60)
9	2024	133,927	176	485	376	(110)
10-year Goal	2025	134,842	175	538	378	(160)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Midland's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0		0
1	2016	132,413	16.40	(19)	49	68
2	2017	131,877	16.80	(39)	48	87
3	2018	131,340	17.20	(58)	48	106
4	2019	130,804	17.60	(76)	48	124
5-year Goal	2020	130,267	18.00	(95)	48	143
6	2021	131,182	18.00	(96)	48	143
7	2022	132,097	18.00	(96)	48	144
8	2023	133,012	18.00	(97)	48	145
9	2024	133,927	18.00	(98)	49	146
10-year Goal	2025	134,842	18.00	(98)	49	147

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 49 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5% increase in 2014
        ii. 5% increase in 2015
        iii. 4.5% increase in 2016
    b. Estimated customer demand reduction of 2.9%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	310	310
2015	311	311
2016	313	313
2017	315	315
2018	317	317
2019	318	318
2020	320	320
2021	322	322
2022	323	323
2023	325	325
2024	327	327
2025	328	328
2026	330	330
2027	332	332
2028	334	334
2029	335	335
2030	337	337
2031	340	340
2032	343	343
2033	346	346
2034	349	349
2035	352	352
2036	355	355
2037	358	358
2038	361	361
2039	364	364
2040	367	367
2041	370	370
2042	373	373
2043	376	376
2044	379	379
2045	383	383
2046	386	386
2047	389	389
2048	392	392
2049	395	395
2050	398	398
2051	402	402
2052	405	405
2053	408	408
2054	412	412
2055	415	415
2056	418	418
2057	421	421
2058	425	425
2059	428	428
2060	431	431
2061	435	435
2062	438	438
2063	441	441
2064	444	444
2065	448	448
2066	451	451
2067	454	454
2068	457	457
2069	461	461
2070	464	464

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	132,950	15.00	49
2016	132,413	15.00	48
2017	131,877	15.00	48
2018	131,340	15.00	48
2019	130,804	15.00	48
2020	130,267	15.00	48
2021	131,182	15.00	48
2022	132,097	15.00	48
2023	133,012	15.00	49
2024	133,927	15.00	49

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region F savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 791 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	313	48	361	791	147	0	147	1,005
2017	315	48	363	795	147	0	147	1,011
2018	317	48	364	800	177	0	177	988
2019	318	48	366	804	206	0	206	964
2020	320	48	367	808	265	0	265	911
2021	322	48	369	813	267	0	267	915
2022	323	48	372	817	269	0	269	919
2023	325	49	374	821	271	0	271	923
2024	327	49	376	825	274	0	274	928
2025	328	49	378	830	276	0	276	932
2026	330	50	380	834	278	0	278	936
2027	332	50	382	838	280	0	280	940
2028	334	50	384	843	282	0	282	944
2029	335	51	386	847	284	0	284	948
2030	337	51	388	851	286	0	286	953
2031	340	51	391	859	290	0	290	961
2032	343	52	395	866	293	0	293	969
2033	346	52	398	874	296	0	296	976
2034	349	53	402	881	299	0	299	984
2035	352	53	405	889	302	0	302	992
2036	355	54	409	896	305	0	305	1,000
2037	358	55	412	904	308	0	308	1,008
2038	361	55	416	911	311	0	311	1,016
2039	364	56	419	919	314	0	314	1,024
2040	367	56	423	927	317	0	317	1,032

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	313	48	361	140	147	0	147	354
2017	315	48	363	141	147	0	147	356
2018	317	48	364	141	177	0	177	329
2019	318	48	366	142	206	0	206	302
2020	320	48	367	143	265	0	265	245
2021	322	48	369	144	267	0	267	246
2022	323	48	372	144	269	0	269	247
2023	325	49	374	145	271	0	271	247
2024	327	49	376	146	274	0	274	248
2025	328	49	378	147	276	0	276	249
2026	330	50	380	147	278	0	278	249
2027	332	50	382	148	280	0	280	250
2028	334	50	384	149	282	0	282	251
2029	335	51	386	150	284	0	284	251
2030	337	51	388	150	286	0	286	252
2031	340	51	391	152	290	0	290	254
2032	343	52	395	153	293	0	293	255
2033	346	52	398	154	296	0	296	257
2034	349	53	402	156	299	0	299	259
2035	352	53	405	157	302	0	302	261
2036	355	54	409	158	305	0	305	262
2037	358	55	412	160	308	0	308	264
2038	361	55	416	161	311	0	311	266
2039	364	56	419	162	314	0	314	268
2040	367	56	423	164	317	0	317	269

Statewide Water Conservation Quantification Project
City of Odessa Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Odessa's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Odessa's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Odessa's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Odessa with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	434	434	104	0	104	331
2016	674	431	1,105	130	0	130	976
2017	681	428	1,109	130	0	130	980
2018	689	425	1,114	156	0	156	958
2019	696	422	1,118	181	0	181	936
2020	703	419	1,122	233	0	233	889
2021	711	424	1,135	237	0	237	898
2022	718	430	1,148	240	0	240	907
2023	725	435	1,160	244	0	244	916
2024	733	441	1,173	248	0	248	926
2025	740	446	1,186	251	0	251	935
2026	747	446	1,193	255	0	255	939
2027	755	452	1,206	258	0	258	948
2028	762	457	1,219	262	0	262	957
2029	769	463	1,232	265	0	265	967
2030	777	468	1,245	269	0	269	976
2031	785	473	1,258	272	0	272	986
2032	793	479	1,272	275	0	275	997
2033	801	485	1,286	279	0	279	1,007
2034	809	491	1,300	282	0	282	1,018
2035	817	497	1,314	285	0	285	1,029
2036	825	502	1,327	288	0	288	1,039
2037	833	508	1,341	291	0	291	1,050
2038	841	514	1,355	295	0	295	1,060
2039	849	520	1,369	298	0	298	1,071
2040	857	525	1,383	301	0	301	1,082
2041	866	531	1,397	304	0	304	1,093
2042	875	537	1,412	308	0	308	1,104
2043	884	543	1,427	311	0	311	1,115
2044	892	549	1,441	314	0	314	1,127
2045	901	555	1,456	318	0	318	1,138
2046	910	561	1,471	321	0	321	1,150
2047	919	567	1,485	324	0	324	1,161
2048	927	573	1,500	328	0	328	1,172
2049	936	578	1,515	331	0	331	1,184
2050	945	584	1,529	334	0	334	1,195
2051	954	590	1,545	338	0	338	1,207
2052	964	596	1,560	341	0	341	1,219
2053	973	602	1,575	344	0	344	1,231
2054	983	608	1,591	348	0	348	1,243
2055	992	614	1,606	351	0	351	1,255
2056	1,001	620	1,622	354	0	354	1,267
2057	1,011	626	1,637	358	0	358	1,279
2058	1,020	632	1,652	361	0	361	1,291
2059	1,030	638	1,668	364	0	364	1,303
2060	1,039	644	1,683	368	0	368	1,316
2061	1,049	650	1,699	371	0	371	1,328
2062	1,058	656	1,714	374	0	374	1,340
2063	1,068	662	1,730	378	0	378	1,352
2064	1,077	668	1,745	381	0	381	1,364
2065	1,087	674	1,761	384	0	384	1,377
2066	1,096	680	1,777	388	0	388	1,389
2067	1,106	686	1,792	391	0	391	1,401
2068	1,116	692	1,808	394	0	394	1,413
2069	1,125	698	1,823	398	0	398	1,426
2070	1,135	704	1,839	401	0	401	1,438

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Odessa's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	152	0	0	0
1	2015	118,968	158	(239)	434	673
2	2016	118,112	163	(474)	1,105	1,579
3	2017	117,255	169	(706)	1,109	1,816
4	2018	116,399	174	(935)	1,114	2,048
5-year Goal	2019	115,542	180	(1,160)	1,118	2,278
6	2020	114,686	179	(1,130)	1,122	2,252
7	2021	116,190	179	(1,124)	1,135	2,259
8	2022	117,694	178	(1,117)	1,148	2,265
9	2023	119,198	178	(1,109)	1,160	2,270
10-year Goal	2024	120,702	177	(1,101)	1,173	2,275

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Odessa's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	22.00	0	0	0
1	2015	118,968	22.00	0	434	434
2	2016	118,112	22.00	0	431	431
3	2017	117,255	22.00	0	428	428
4	2018	116,399	22.00	0	425	425
5-year Goal	2019	115,542	22.00	0	422	422
6	2020	114,686	21.80	8	419	410
7	2021	116,190	21.60	17	424	407
8	2022	117,694	21.40	26	430	404
9	2023	119,198	21.20	35	435	400
10-year Goal	2024	120,702	21.00	44	441	397

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 434 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 40% increase in 2012
        ii. 8% increase in 2015
    b. Estimated customer demand reduction of 9.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015		0
2016	674	674
2017	681	681
2018	689	689
2019	696	696
2020	703	703
2021	711	711
2022	718	718
2023	725	725
2024	733	733
2025	740	740
2026	747	747
2027	755	755
2028	762	762
2029	769	769
2030	777	777
2031	785	785
2032	793	793
2033	801	801
2034	809	809
2035	817	817
2036	825	825
2037	833	833
2038	841	841
2039	849	849
2040	857	857
2041	866	866
2042	875	875
2043	884	884
2044	892	892
2045	901	901
2046	910	910
2047	919	919
2048	927	927
2049	936	936
2050	945	945
2051	954	954
2052	964	964
2053	973	973
2054	983	983
2055	992	992
2056	1,001	1,001
2057	1,011	1,011
2058	1,020	1,020
2059	1,030	1,030
2060	1,039	1,039
2061	1,049	1,049
2062	1,058	1,058
2063	1,068	1,068
2064	1,077	1,077
2065	1,087	1,087
2066	1,096	1,096
2067	1,106	1,106
2068	1,116	1,116
2069	1,125	1,125
2070	1,135	1,135

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	22.00	0
2015	118,968	12.00	434
2016	118,112	12.00	431
2017	117,255	12.00	428
2018	116,399	12.00	425
2019	115,542	12.00	422
2020	114,686	12.00	419
2021	116,190	12.00	424
2022	117,694	12.00	430
2023	119,198	12.00	435
2024	120,702	12.00	441

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.79% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 547 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	674	431	1,105	547	130	0	130	1,522
2017	681	428	1,109	553	130	0	130	1,533
2018	689	425	1,114	559	156	0	156	1,517
2019	696	422	1,118	565	181	0	181	1,501
2020	703	419	1,122	571	233	0	233	1,459
2021	711	424	1,135	577	237	0	237	1,475
2022	718	430	1,148	583	240	0	240	1,490
2023	725	435	1,160	589	244	0	244	1,505
2024	733	441	1,173	595	248	0	248	1,520
2025	740	446	1,186	601	251	0	251	1,536
2026	747	446	1,193	606	255	0	255	1,545
2027	755	452	1,206	612	258	0	258	1,560
2028	762	457	1,219	618	262	0	262	1,576
2029	769	463	1,232	624	265	0	265	1,591
2030	777	468	1,245	630	269	0	269	1,606
2031	785	473	1,258	637	272	0	272	1,623
2032	793	479	1,272	643	275	0	275	1,640
2033	801	485	1,286	650	279	0	279	1,657
2034	809	491	1,300	656	282	0	282	1,674
2035	817	497	1,314	663	285	0	285	1,692
2036	825	502	1,327	669	288	0	288	1,709
2037	833	508	1,341	676	291	0	291	1,726
2038	841	514	1,355	683	295	0	295	1,743
2039	849	520	1,369	689	298	0	298	1,760
2040	857	525	1,383	696	301	0	301	1,777

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	674	431	1,105	94	130	0	130	1,070
2017	681	428	1,109	95	130	0	130	1,075
2018	689	425	1,114	96	156	0	156	1,054
2019	696	422	1,118	97	181	0	181	1,033
2020	703	419	1,122	98	233	0	233	987
2021	711	424	1,135	99	237	0	237	997
2022	718	430	1,148	100	240	0	240	1,007
2023	725	435	1,160	101	244	0	244	1,018
2024	733	441	1,173	102	248	0	248	1,028
2025	740	446	1,186	103	251	0	251	1,038
2026	747	446	1,193	104	255	0	255	1,043
2027	755	452	1,206	105	258	0	258	1,053
2028	762	457	1,219	106	262	0	262	1,064
2029	769	463	1,232	107	265	0	265	1,074
2030	777	468	1,245	108	269	0	269	1,084
2031	785	473	1,258	110	272	0	272	1,096
2032	793	479	1,272	111	275	0	275	1,107
2033	801	485	1,286	112	279	0	279	1,119
2034	809	491	1,300	113	282	0	282	1,131
2035	817	497	1,314	114	285	0	285	1,143
2036	825	502	1,327	115	288	0	288	1,154
2037	833	508	1,341	116	291	0	291	1,166
2038	841	514	1,355	117	295	0	295	1,178
2039	849	520	1,369	119	298	0	298	1,189
2040	857	525	1,383	120	301	0	301	1,201

Statewide Water Conservation Quantification Project
City of San Angelo Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares San Angelo's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) San Angelo's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in San Angelo's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for San Angelo with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	429	110	539	95	0	95	444
2016	559	111	670	119	0	119	551
2017	692	112	804	119	0	119	685
2018	699	113	812	143	0	143	669
2019	705	114	819	166	0	166	653
2020	712	115	827	214	0	214	614
2021	719	117	836	217	0	217	619
2022	726	118	844	220	0	220	624
2023	733	119	852	223	0	223	629
2024	740	121	861	226	0	226	634
2025	747	122	869	230	0	230	639
2026	753	124	877	233	0	233	645
2027	760	125	886	236	0	236	650
2028	767	127	894	239	0	239	655
2029	774	128	902	242	0	242	660
2030	781	130	911	245	0	245	665
2031	784	131	915	247	0	247	668
2032	788	131	919	248	0	248	671
2033	791	132	923	249	0	249	674
2034	794	133	927	251	0	251	677
2035	798	134	931	252	0	252	679
2036	801	135	935	253	0	253	682
2037	804	135	939	255	0	255	685
2038	807	136	944	256	0	256	688
2039	811	137	948	257	0	257	691
2040	814	138	952	258	0	258	693
2041	818	139	957	260	0	260	697
2042	823	139	962	262	0	262	700
2043	827	140	967	263	0	263	704
2044	831	141	972	265	0	265	707
2045	835	142	977	266	0	266	711
2046	839	143	982	268	0	268	714
2047	844	144	987	270	0	270	718
2048	848	145	992	271	0	271	721
2049	852	145	997	273	0	273	725
2050	856	146	1,002	274	0	274	728
2051	861	147	1,009	276	0	276	732
2052	866	148	1,015	278	0	278	737
2053	872	149	1,021	279	0	279	741
2054	877	150	1,027	281	0	281	745
2055	882	151	1,033	283	0	283	750
2056	887	152	1,039	285	0	285	754
2057	892	153	1,045	286	0	286	758
2058	897	154	1,051	288	0	288	763
2059	902	154	1,057	290	0	290	767
2060	907	155	1,063	291	0	291	771
2061	913	156	1,069	293	0	293	776
2062	918	157	1,076	295	0	295	781
2063	924	158	1,082	297	0	297	785
2064	929	159	1,089	299	0	299	790
2065	935	160	1,095	300	0	300	795
2066	941	161	1,102	302	0	302	799
2067	946	162	1,108	304	0	304	804
2068	952	163	1,115	306	0	306	809
2069	957	164	1,121	307	0	307	814
2070	963	165	1,128	309	0	309	818

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how San Angelo's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	156	0	0	0
1	2015	100,450	155	44	539	495
2	2016	101,377	154	89	670	581
3	2017	102,303	152	134	804	669
4	2018	103,230	151	181	812	631
5-year Goal	2019	104,156	150	228	819	591
6	2020	105,083	149	268	827	559
7	2021	106,423	148	311	836	525
8	2022	107,762	147	354	844	490
9	2023	109,102	146	398	852	454
10-year Goal	2024	110,442	145	443	861	417

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how San Angelo's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2015	100,450	18.60	15	110	95
2	2016	101,377	18.20	30	111	81
3	2017	102,303	17.80	45	112	67
4	2018	103,230	17.40	60	113	53
5-year Goal	2019	104,156	17.00	76	114	38
6	2020	105,083	16.60	92	115	23
7	2021	106,423	16.20	109	117	8
8	2022	107,762	15.80	126	118	(8)
9	2023	109,102	15.40	143	119	(24)
10-year Goal	2024	110,442	15.00	161	121	(40)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 110 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 11.75% increase in 2016
        ii. 11.75% increase in 2017
    b. Estimated customer demand reduction of 4.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 7.58% of total utility demand (Hermitte and Mace 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    i. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Watering Ordinance	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014		425	424.6
2015		429	429.0
2016	126	433	559.1
2017	254	438	691.7
2018	257	442	698.6
2019	259	446	705.4
2020	262	451	712.3
2021	264	455	719.2
2022	267	459	726.0
2023	269	464	732.9
2024	272	468	739.8
2025	274	472	746.6
2026	277	477	753.5
2027	279	481	760.3
2028	282	485	767.2
2029	284	490	774.1
2030	287	494	780.9
2031	288	496	784.2
2032	289	498	787.6
2033	290	500	790.9
2034	292	503	794.2
2035	293	505	797.5
2036	294	507	800.8
2037	295	509	804.1
2038	297	511	807.5
2039	298	513	810.8
2040	299	515	814.1
2041	301	518	818.3
2042	302	520	822.5
2043	304	523	826.7
2044	305	526	830.9
2045	307	528	835.1
2046	308	531	839.4
2047	310	534	843.6
2048	311	536	847.8
2049	313	539	852.0
2050	314	542	856.2
2051	316	545	861.3
2052	318	548	866.4
2053	320	551	871.6
2054	322	555	876.7
2055	324	558	881.8
2056	326	561	886.9
2057	328	564	892.0
2058	329	568	897.1
2059	331	571	902.2
2060	333	574	907.4
2061	335	578	912.9
2062	337	581	918.4
2063	339	585	923.9
2064	341	588	929.5
2065	343	592	935.0
2066	345	595	940.5
2067	347	599	946.0
2068	349	602	951.6
2069	352	606	957.1
2070	354	609	962.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	19.00	0
2015	100,450	16.00	110
2016	101,377	16.00	111
2017	102,303	16.00	112
2018	103,230	16.00	113
2019	104,156	16.00	114
2020	105,083	16.00	115
2021	106,423	16.00	117
2022	107,762	16.00	118
2023	109,102	16.00	119
2024	110,442	16.00	121

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	559	111	670	77	119	0	119	628
2017	692	112	804	77	119	0	119	762
2018	699	113	812	78	143	0	143	747
2019	705	114	819	79	166	0	166	732
2020	712	115	827	80	214	0	214	693
2021	719	117	836	80	217	0	217	699
2022	726	118	844	81	220	0	220	705
2023	733	119	852	82	223	0	223	711
2024	740	121	861	83	226	0	226	717
2025	747	122	869	84	230	0	230	723
2026	753	124	877	84	233	0	233	729
2027	760	125	886	85	236	0	236	735
2028	767	127	894	86	239	0	239	741
2029	774	128	902	87	242	0	242	747
2030	781	130	911	87	245	0	245	753
2031	784	131	915	88	247	0	247	756
2032	788	131	919	88	248	0	248	759
2033	791	132	923	88	249	0	249	762
2034	794	133	927	89	251	0	251	765
2035	798	134	931	89	252	0	252	769
2036	801	135	935	90	253	0	253	772
2037	804	135	939	90	255	0	255	775
2038	807	136	944	90	256	0	256	778
2039	811	137	948	91	257	0	257	781
2040	814	138	952	91	258	0	258	784

TWDB Statewide Water Conservation Quantification Project
City of Snyder Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Snyder's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Snyder's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Snyder's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Snyder with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	0	0	11	0	11	(11)
2016	0	0	0	14	0	14	(14)
2017	0	0	0	14	0	14	(14)
2018	0	0	0	16	0	16	(16)
2019	0	0	0	19	0	19	(19)
2020	0	0	0	24	0	24	(24)
2021	0	0	0	25	0	25	(25)
2022	0	0	0	25	0	25	(25)
2023	0	0	0	26	0	26	(26)
2024	0	0	0	26	0	26	(26)
2025	0	0	0	26	0	26	(26)
2026	0	0	0	27	0	27	(27)
2027	0	0	0	27	0	27	(27)
2028	0	0	0	27	0	27	(27)
2029	0	0	0	28	0	28	(28)
2030	0	0	0	28	0	28	(28)
2031	0	0	0	28	0	28	(28)
2032	0	0	0	28	0	28	(28)
2033	0	0	0	29	0	29	(29)
2034	0	0	0	29	0	29	(29)
2035	0	0	0	29	0	29	(29)
2036	0	0	0	29	0	29	(29)
2037	0	0	0	30	0	30	(30)
2038	0	0	0	30	0	30	(30)
2039	0	0	0	30	0	30	(30)
2040	0	0	0	30	0	30	(30)
2041	0	0	0	31	0	31	(31)
2042	0	0	0	31	0	31	(31)
2043	0	0	0	31	0	31	(31)
2044	0	0	0	31	0	31	(31)
2045	0	0	0	31	0	31	(31)
2046	0	0	0	32	0	32	(32)
2047	0	0	0	32	0	32	(32)
2048	0	0	0	32	0	32	(32)
2049	0	0	0	32	0	32	(32)
2050	0	0	0	33	0	33	(33)
2051	0	0	0	33	0	33	(33)
2052	0	0	0	33	0	33	(33)
2053	0	0	0	33	0	33	(33)
2054	0	0	0	33	0	33	(33)
2055	0	0	0	33	0	33	(33)
2056	0	0	0	33	0	33	(33)
2057	0	0	0	34	0	34	(34)
2058	0	0	0	34	0	34	(34)
2059	0	0	0	34	0	34	(34)
2060	0	0	0	34	0	34	(34)
2061	0	0	0	35	0	35	(35)
2062	0	0	0	36	0	36	(36)
2063	0	0	0	37	0	37	(37)
2064	0	0	0	38	0	38	(38)
2065	0	0	0	39	0	39	(39)
2066	0	0	0	40	0	40	(40)
2067	0	0	0	41	0	41	(41)
2068	0	0	0	42	0	42	(42)
2069	0	0	0	43	0	43	(43)
2070	0	0	0	44	0	44	(44)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Snyder's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	139	0	0	0
1	2015	11,768	137	8	0	(8)
2	2016	12,151	135	16	0	(16)
3	2017	12,534	134	25	0	(25)
4	2018	12,916	132	34	0	(34)
5-year Goal	2019	13,299	130	44	0	(44)
6	2020	13,682	127	60	0	(60)
7	2021	13,888	124	76	0	(76)
8	2022	14,093	121	93	0	(93)
9	2023	14,299	118	110	0	(110)
10-year Goal	2024	14,504	115	127	0	(127)

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Snyder's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	4.00	0	0	0
1	2015	11,768	4.60	(3)	0	3
2	2016	12,151	5.20	(5)	0	5
3	2017	12,534	5.80	(8)	0	8
4	2018	12,916	6.40	(11)	0	11
5-year Goal	2019	13,299	7.00	(15)	0	15
6	2020	13,682	6.60	(13)	0	13
7	2021	13,888	6.20	(11)	0	11
8	2022	14,093	5.80	(9)	0	9
9	2023	14,299	5.40	(7)	0	7
10-year Goal	2024	14,504	5.00	(5)	0	5

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.

- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	4.00	0
2015	11,768	4.00	0
2016	12,151	4.00	0
2017	12,534	4.00	0
2018	12,916	4.00	0
2019	13,299	4.00	0
2020	13,682	4.00	0
2021	13,888	4.00	0
2022	14,093	4.00	0
2023	14,299	4.00	0
2024	14,504	4.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        - i. Average Region F savings
        - ii. Specific percentage of outdoor usage unknown for your utility at this time
    - **b.** Savings could be 48 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	48	14	0	14	34
2017	0	0	0	49	14	0	14	35
2018	0	0	0	49	16	0	16	33
2019	0	0	0	50	19	0	19	31
2020	0	0	0	50	24	0	24	26
2021	0	0	0	51	25	0	25	26
2022	0	0	0	51	25	0	25	26
2023	0	0	0	52	26	0	26	26
2024	0	0	0	53	26	0	26	27
2025	0	0	0	53	26	0	26	27
2026	0	0	0	54	27	0	27	27
2027	0	0	0	54	27	0	27	27
2028	0	0	0	55	27	0	27	27
2029	0	0	0	55	28	0	28	28
2030	0	0	0	56	28	0	28	28
2031	0	0	0	56	28	0	28	28
2032	0	0	0	57	28	0	28	28
2033	0	0	0	57	29	0	29	28
2034	0	0	0	57	29	0	29	28
2035	0	0	0	57	29	0	29	28
2036	0	0	0	58	29	0	29	28
2037	0	0	0	58	30	0	30	28
2038	0	0	0	58	30	0	30	28
2039	0	0	0	59	30	0	30	29
2040	0	0	0	59	30	0	30	29

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	8	14	0	14	(5)
2017	0	0	0	9	14	0	14	(5)
2018	0	0	0	9	16	0	16	(8)
2019	0	0	0	9	19	0	19	(10)
2020	0	0	0	9	24	0	24	(16)
2021	0	0	0	9	25	0	25	(16)
2022	0	0	0	9	25	0	25	(16)
2023	0	0	0	9	26	0	26	(16)
2024	0	0	0	9	26	0	26	(17)
2025	0	0	0	9	26	0	26	(17)
2026	0	0	0	9	27	0	27	(17)
2027	0	0	0	10	27	0	27	(17)
2028	0	0	0	10	27	0	27	(18)
2029	0	0	0	10	28	0	28	(18)
2030	0	0	0	10	28	0	28	(18)
2031	0	0	0	10	28	0	28	(18)
2032	0	0	0	10	28	0	28	(18)
2033	0	0	0	10	29	0	29	(19)
2034	0	0	0	10	29	0	29	(19)
2035	0	0	0	10	29	0	29	(19)
2036	0	0	0	10	29	0	29	(19)
2037	0	0	0	10	30	0	30	(19)
2038	0	0	0	10	30	0	30	(20)
2039	0	0	0	10	30	0	30	(20)
2040	0	0	0	10	30	0	30	(20)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 13 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	13	14	0	14	(1)
2017	0	0	0	13	14	0	14	(1)
2018	0	0	0	13	16	0	16	(3)
2019	0	0	0	13	19	0	19	(6)
2020	0	0	0	13	24	0	24	(11)
2021	0	0	0	13	25	0	25	(11)
2022	0	0	0	14	25	0	25	(12)
2023	0	0	0	14	26	0	26	(12)
2024	0	0	0	14	26	0	26	(12)
2025	0	0	0	14	26	0	26	(12)
2026	0	0	0	14	27	0	27	(12)
2027	0	0	0	14	27	0	27	(13)
2028	0	0	0	14	27	0	27	(13)
2029	0	0	0	15	28	0	28	(13)
2030	0	0	0	15	28	0	28	(13)
2031	0	0	0	15	28	0	28	(13)
2032	0	0	0	15	28	0	28	(14)
2033	0	0	0	15	29	0	29	(14)
2034	0	0	0	15	29	0	29	(14)
2035	0	0	0	15	29	0	29	(14)
2036	0	0	0	15	29	0	29	(14)
2037	0	0	0	15	30	0	30	(14)
2038	0	0	0	15	30	0	30	(14)
2039	0	0	0	15	30	0	30	(15)
2040	0	0	0	16	30	0	30	(15)

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Winters Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Winters's current water conservation activities and their quantified savings to two metrics: 1) Region F Water Plan's (Texas Water Development Board, 2016e) recommended WMS supply volumes for municipal conservation, and 2) Winters's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Winters's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8][9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Winters with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.4	17	18	2	0	2	16
2016	0.9	17	18	3	0	3	16
2017	0.9	17	18	3	0	3	16
2018	0.9	17	18	3	0	3	15
2019	0.9	17	18	4	0	4	15
2020	0.9	17	18	5	0	5	14
2021	0.9	17	18	5	0	5	14
2022	0.9	17	18	5	0	5	14
2023	0.9	17	18	5	0	5	14
2024	0.9	17	18	5	0	5	14
2025	0.9	18	18	5	0	5	14
2026	0.9	18	18	5	0	5	14
2027	0.9	18	19	5	0	5	14
2028	0.9	18	19	5	0	5	14
2029	0.9	18	19	5	0	5	14
2030	0.9	18	19	5	0	5	14
2031	0.8	18	19	5	0	5	14
2032	0.8	18	19	5	0	5	14
2033	0.8	18	19	5	0	5	14
2034	0.8	18	19	5	0	5	14
2035	0.8	18	19	5	0	5	14
2036	0.8	18	19	5	0	5	14
2037	0.8	18	19	5	0	5	14
2038	0.8	18	19	5	0	5	14
2039	0.8	18	19	5	0	5	14
2040	0.8	18	19	5	0	5	14
2041	0.8	18	19	5	0	5	14
2042	0.8	18	19	5	0	5	14
2043	0.8	18	19	5	0	5	14
2044	0.8	19	19	5	0	5	14
2045	0.8	19	19	5	0	5	14
2046	0.8	19	19	5	0	5	15
2047	0.8	19	19	5	0	5	15
2048	0.8	19	20	5	0	5	15
2049	0.8	19	20	5	0	5	15
2050	0.8	19	20	5	0	5	15
2051	0.8	19	20	5	0	5	15
2052	0.8	19	20	5	0	5	15
2053	0.8	19	20	5	0	5	15
2054	0.8	19	20	5	0	5	15
2055	0.8	19	20	5	0	5	15
2056	0.8	19	20	5	0	5	15
2057	0.8	19	20	5	0	5	15
2058	0.8	19	20	5	0	5	15
2059	0.8	19	20	5	0	5	15
2060	0.8	19	20	5	0	5	15
2061	0.8	19	20	5	0	5	15
2062	0.8	19	20	5	0	5	15
2063	0.8	19	20	5	0	5	15
2064	0.8	19	20	5	0	5	15
2065	0.8	19	20	5	0	5	15
2066	0.8	19	20	5	0	5	15
2067	0.8	19	20	5	0	5	15
2068	0.8	19	20	5	0	5	15
2069	0.8	19	20	5	0	5	15
2070	0.8	19	20	5	0	5	15

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Winters's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	111	0	0	0
1	2015	2,974	111	0	18	18
2	2016	2,969	111	0	18	18
3	2017	2,965	111	0	18	18
4	2018	2,960	111	0	18	18
5-year Goal	2019	2,956	111	0	18	18
6	2020	2,951	111	0	18	18
7	2021	2,962	111	0	18	18
8	2022	2,972	111	0	18	18
9	2023	2,983	111	0	18	18
10-year Goal	2024	2,993	111	0	18	18

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic 5-year average for total GPCD from the utility's most recently submitted 5-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Winters's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	2,974	17.00	0	17	17
2	2016	2,969	17.00	0	17	17
3	2017	2,965	17.00	0	17	17
4	2018	2,960	17.00	0	17	17
5-year Goal	2019	2,956	17.00	0	17	17
6	2020	2,951	17.00	0	17	17
7	2021	2,962	17.00	0	17	17
8	2022	2,972	17.00	0	17	17
9	2023	2,983	17.00	0	17	17
10-year Goal	2024	2,993	17.00	0	17	17

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 17 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 2.7% increase in 2013
        ii. 3.6% increase in 2016
    b. Estimated customer demand reduction of 1.26%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013	0.36	0.4
2014	0.36	0.4
2015	0.36	0.4
2016	0.90	0.9
2017	0.90	0.9
2018	0.89	0.9
2019	0.89	0.9
2020	0.89	0.9
2021	0.88	0.9
2022	0.88	0.9
2023	0.88	0.9
2024	0.87	0.9
2025	0.87	0.9
2026	0.86	0.9
2027	0.86	0.9
2028	0.86	0.9
2029	0.85	0.9
2030	0.85	0.9
2031	0.85	0.8
2032	0.84	0.8
2033	0.84	0.8
2034	0.83	0.8
2035	0.83	0.8
2036	0.83	0.8
2037	0.82	0.8
2038	0.82	0.8
2039	0.81	0.8
2040	0.81	0.8
2041	0.81	0.8
2042	0.81	0.8
2043	0.81	0.8
2044	0.81	0.8
2045	0.81	0.8
2046	0.81	0.8
2047	0.81	0.8
2048	0.81	0.8
2049	0.81	0.8
2050	0.80	0.8
2051	0.80	0.8
2052	0.80	0.8
2053	0.80	0.8
2054	0.80	0.8
2055	0.80	0.8
2056	0.80	0.8
2057	0.80	0.8
2058	0.80	0.8
2059	0.80	0.8
2060	0.80	0.8
2061	0.80	0.8
2062	0.80	0.8
2063	0.80	0.8
2064	0.80	0.8
2065	0.80	0.8
2066	0.80	0.8
2067	0.80	0.8
2068	0.80	0.8
2069	0.80	0.8
2070	0.80	0.8

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	2,974	1.00	17
2016	2,969	1.00	17
2017	2,965	1.00	17
2018	2,960	1.00	17
2019	2,956	1.00	17
2020	2,951	1.00	17
2021	2,962	1.00	17
2022	2,972	1.00	17
2023	2,983	1.00	17
2024	2,993	1.00	17

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        - i. Average Region F savings
        - ii. Specific percentage of outdoor usage unknown for your utility at this time
    - **b.** Savings could be 5 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	17	18	5	3	0	3	21
2017	1	17	18	5	3	0	3	21
2018	1	17	18	5	3	0	3	21
2019	1	17	18	5	4	0	4	20
2020	1	17	18	5	5	0	5	19
2021	1	17	18	5	5	0	5	19
2022	1	17	18	5	5	0	5	19
2023	1	17	18	5	5	0	5	19
2024	1	17	18	5	5	0	5	19
2025	1	18	18	5	5	0	5	19
2026	1	18	18	5	5	0	5	19
2027	1	18	19	5	5	0	5	19
2028	1	18	19	5	5	0	5	19
2029	1	18	19	5	5	0	5	19
2030	1	18	19	5	5	0	5	19
2031	1	18	19	5	5	0	5	19
2032	1	18	19	5	5	0	5	19
2033	1	18	19	5	5	0	5	19
2034	1	18	19	5	5	0	5	19
2035	1	18	19	5	5	0	5	19
2036	1	18	19	5	5	0	5	19
2037	1	18	19	5	5	0	5	19
2038	1	18	19	5	5	0	5	19
2039	1	18	19	5	5	0	5	19
2040	1	18	19	5	5	0	5	19

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	17	18	1	3	0	3	17
2017	1	17	18	1	3	0	3	17
2018	1	17	18	1	3	0	3	16
2019	1	17	18	1	4	0	4	16
2020	1	17	18	1	5	0	5	15
2021	1	17	18	1	5	0	5	15
2022	1	17	18	1	5	0	5	15
2023	1	17	18	1	5	0	5	15
2024	1	17	18	1	5	0	5	15
2025	1	18	18	1	5	0	5	15
2026	1	18	18	1	5	0	5	15
2027	1	18	19	1	5	0	5	15
2028	1	18	19	1	5	0	5	15
2029	1	18	19	1	5	0	5	15
2030	1	18	19	1	5	0	5	15
2031	1	18	19	1	5	0	5	15
2032	1	18	19	1	5	0	5	15
2033	1	18	19	1	5	0	5	15
2034	1	18	19	1	5	0	5	15
2035	1	18	19	1	5	0	5	15
2036	1	18	19	1	5	0	5	15
2037	1	18	19	1	5	0	5	15
2038	1	18	19	1	5	0	5	15
2039	1	18	19	1	5	0	5	15
2040	1	18	19	1	5	0	5	15

Region G Individual Reports

TWDB Statewide Water Conservation Quantification Project
City of Abilene Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Abilene's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Abilene's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Abilene's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Abilene with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	46	46	103	0	103	(57)
2016	250	46	296	129	0	129	167
2017	472	46	517	129	0	129	389
2018	472	46	518	154	0	154	364
2019	473	46	519	180	0	180	339
2020	474	46	520	231	0	231	289
2021	475	46	521	284	0	284	237
2022	476	46	522	337	0	337	185
2023	477	46	523	390	0	390	134
2024	478	47	525	443	0	443	82
2025	479	47	526	496	0	496	30
2026	480	47	527	548	0	548	(21)
2027	481	47	528	601	0	601	(73)
2028	482	47	529	654	0	654	(125)
2029	483	48	530	707	0	707	(177)
2030	484	48	531	760	0	760	(228)
2031	484	48	532	757	0	757	(225)
2032	485	48	533	754	0	754	(221)
2033	486	48	534	751	0	751	(217)
2034	487	49	535	749	0	749	(213)
2035	487	49	536	746	0	746	(210)
2036	488	49	537	743	0	743	(206)
2037	489	49	538	740	0	740	(202)
2038	490	49	539	738	0	738	(199)
2039	490	49	540	735	0	735	(195)
2040	491	50	541	732	0	732	(191)
2041	492	50	542	725	0	725	(184)
2042	493	50	543	719	0	719	(176)
2043	494	50	544	712	0	712	(169)
2044	494	50	545	706	0	706	(161)
2045	495	50	546	699	0	699	(154)
2046	496	50	547	693	0	693	(146)
2047	497	51	548	686	0	686	(139)
2048	498	51	548	680	0	680	(131)
2049	499	51	549	673	0	673	(124)
2050	499	51	550	666	0	666	(116)
2051	500	51	551	666	0	666	(115)
2052	501	51	552	666	0	666	(114)
2053	502	51	554	666	0	666	(112)
2054	503	51	555	666	0	666	(111)
2055	504	51	556	666	0	666	(110)
2056	505	52	557	665	0	665	(109)
2057	506	52	558	665	0	665	(108)
2058	507	52	559	665	0	665	(106)
2059	508	52	560	665	0	665	(105)
2060	509	52	561	665	0	665	(104)
2061	509	52	562	666	0	666	(104)
2062	510	52	562	667	0	667	(104)
2063	511	52	563	667	0	667	(104)
2064	512	52	564	668	0	668	(104)
2065	513	52	565	669	0	669	(104)
2066	513	53	566	670	0	670	(104)
2067	514	53	567	671	0	671	(104)
2068	515	53	568	672	0	672	(104)
2069	516	53	568	673	0	673	(104)
2070	516	53	569	674	0	674	(104)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Abilene's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	162	0	0	0
1	2015	124,893	162	0	46	46
2	2016	124,950	162	0	296	296
3	2017	125,007	162	0	517	517
4	2018	125,065	162	0	518	518
5-year Goal	2019	125,122	162	0	519	519
6	2020	125,179	162	18	520	502
7	2021	125,765	161	37	521	484
8	2022	126,350	161	55	522	467
9	2023	126,936	160	74	523	449
10-year Goal	2024	127,522	160	93	525	432

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Abilene's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	26.00	0	0	0
1	2015	124,893	26.00	0	46	46
2	2016	124,950	26.00	0	46	46
3	2017	125,007	26.00	0	46	46
4	2018	125,065	26.00	0	46	46
5-year Goal	2019	125,122	26.00	0	46	46
6	2020	125,179	26.00	0	46	46
7	2021	125,765	26.00	0	46	46
8	2022	126,350	26.00	0	46	46
9	2023	126,936	26.00	0	46	46
10-year Goal	2024	127,522	26.00	0	47	47

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.

- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 46 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 17% increase in 2016
        ii. 20% increase in 2017
    b. Estimated customer demand reduction of 6.4%

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.

c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)

a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015		0
2016	250.0	250
2017	471.6	472
2018	472.5	472
2019	473.4	473
2020	474.3	474
2021	475.3	475
2022	476.2	476
2023	477.1	477
2024	478.1	478
2025	479.0	479
2026	479.9	480
2027	480.9	481
2028	481.8	482
2029	482.7	483
2030	483.6	484
2031	484.4	484
2032	485.1	485
2033	485.9	486
2034	486.6	487
2035	487.4	487
2036	488.2	488
2037	488.9	489
2038	489.7	490
2039	490.4	490
2040	491.2	491
2041	492.0	492
2042	492.8	493
2043	493.6	494
2044	494.5	494
2045	495.3	495
2046	496.1	496
2047	497.0	497
2048	497.8	498
2049	498.6	499
2050	499.5	499
2051	500.4	500
2052	501.3	501
2053	502.2	502
2054	503.2	503
2055	504.1	504
2056	505.0	505
2057	505.9	506
2058	506.9	507
2059	507.8	508
2060	508.7	509
2061	509.5	509
2062	510.3	510
2063	511.0	511
2064	511.8	512
2065	512.6	513
2066	513.4	513
2067	514.1	514
2068	514.9	515
2069	515.7	516
2070	516.5	516

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	12.00	0
2015	124,893	11.00	46
2016	124,950	11.00	46
2017	125,007	11.00	46
2018	125,065	11.00	46
2019	125,122	11.00	46
2020	125,179	11.00	46
2021	125,765	11.00	46
2022	126,350	11.00	46
2023	126,936	11.00	46
2024	127,522	11.00	47

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region G savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 557 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	250	46	296	557	129	0	129	724
2017	472	46	517	558	129	0	129	947
2018	472	46	518	560	154	0	154	923
2019	473	46	519	561	180	0	180	900
2020	474	46	520	562	231	0	231	850
2021	475	46	521	563	284	0	284	800
2022	476	46	522	564	337	0	337	749
2023	477	46	523	565	390	0	390	699
2024	478	47	525	566	443	0	443	648
2025	479	47	526	567	496	0	496	598
2026	480	47	527	568	548	0	548	547
2027	481	47	528	570	601	0	601	496
2028	482	47	529	571	654	0	654	446
2029	483	48	530	572	707	0	707	395
2030	484	48	531	573	760	0	760	345
2031	484	48	532	574	757	0	757	349
2032	485	48	533	575	754	0	754	354
2033	486	48	534	575	751	0	751	358
2034	487	49	535	576	749	0	749	363
2035	487	49	536	577	746	0	746	368
2036	488	49	537	578	743	0	743	372
2037	489	49	538	579	740	0	740	377
2038	490	49	539	580	738	0	738	381
2039	490	49	540	581	735	0	735	386
2040	491	50	541	582	732	0	732	390

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	250	46	296	99	129	0	129	266
2017	472	46	517	99	129	0	129	487
2018	472	46	518	99	154	0	154	463
2019	473	46	519	99	180	0	180	438
2020	474	46	520	99	231	0	231	388
2021	475	46	521	100	284	0	284	336
2022	476	46	522	100	337	0	337	285
2023	477	46	523	100	390	0	390	233
2024	478	47	525	100	443	0	443	182
2025	479	47	526	100	496	0	496	131
2026	480	47	527	100	548	0	548	79
2027	481	47	528	101	601	0	601	28
2028	482	47	529	101	654	0	654	(24)
2029	483	48	530	101	707	0	707	(75)
2030	484	48	531	101	760	0	760	(127)
2031	484	48	532	101	757	0	757	(123)
2032	485	48	533	102	754	0	754	(119)
2033	486	48	534	102	751	0	751	(115)
2034	487	49	535	102	749	0	749	(112)
2035	487	49	536	102	746	0	746	(108)
2036	488	49	537	102	743	0	743	(104)
2037	489	49	538	102	740	0	740	(100)
2038	490	49	539	103	738	0	738	(96)
2039	490	49	540	103	735	0	735	(92)
2040	491	50	541	103	732	0	732	(88)

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Bethesda WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Bethesda WSC's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Bethesda WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Bethesda WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Bethesda WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(20)	(20)	22	1	23	(43)
2016	0	(20)	(20)	27	2	29	(50)
2017	0	(21)	(21)	27	2	30	(50)
2018	0	(21)	(21)	33	3	35	(57)
2019	0	(22)	(22)	38	3	41	(63)
2020	0	(22)	(22)	49	3	52	(75)
2021	0	(23)	(23)	59	3	62	(85)
2022	0	(23)	(23)	69	3	72	(95)
2023	0	(23)	(23)	79	3	82	(106)
2024	0	(24)	(24)	89	3	92	(116)
2025	0	(24)	(24)	99	3	102	(126)
2026	0	(24)	(24)	109	3	112	(137)
2027	0	(25)	(25)	119	3	122	(147)
2028	0	(25)	(25)	129	3	132	(157)
2029	0	(25)	(25)	139	3	142	(168)
2030	0	(26)	(26)	149	3	152	(178)
2031	0	(26)	(26)	161	3	164	(191)
2032	0	(27)	(27)	174	3	176	(203)
2033	0	(27)	(27)	186	2	188	(215)
2034	0	(28)	(28)	198	2	200	(228)
2035	0	(28)	(28)	211	2	212	(240)
2036	0	(28)	(28)	223	1	224	(253)
2037	0	(29)	(29)	235	1	236	(265)
2038	0	(29)	(29)	247	1	248	(277)
2039	0	(30)	(30)	260	0	260	(290)
2040	0	(30)	(30)	272	0	272	(302)
2041	0	(31)	(31)	281	0	281	(311)
2042	0	(31)	(31)	289	0	289	(320)
2043	0	(32)	(32)	298	0	298	(330)
2044	0	(32)	(32)	307	0	307	(339)
2045	0	(33)	(33)	315	0	315	(348)
2046	0	(33)	(33)	324	0	324	(357)
2047	0	(34)	(34)	333	0	333	(366)
2048	0	(34)	(34)	341	0	341	(376)
2049	0	(35)	(35)	350	0	350	(385)
2050	0	(35)	(35)	359	0	359	(394)
2051	0	(36)	(36)	363	0	363	(399)
2052	0	(36)	(36)	368	0	368	(404)
2053	0	(37)	(37)	372	0	372	(409)
2054	0	(37)	(37)	377	0	377	(414)
2055	0	(38)	(38)	381	0	381	(419)
2056	0	(39)	(39)	386	0	386	(424)
2057	0	(39)	(39)	390	0	390	(430)
2058	0	(40)	(40)	395	0	395	(435)
2059	0	(40)	(40)	399	0	399	(440)
2060	0	(41)	(41)	404	0	404	(445)
2061	0	(41)	(41)	409	0	409	(450)
2062	0	(42)	(42)	414	0	414	(456)
2063	0	(43)	(43)	419	0	419	(461)
2064	0	(43)	(43)	423	0	423	(467)
2065	0	(44)	(44)	428	0	428	(472)
2066	0	(44)	(44)	433	0	433	(477)
2067	0	(45)	(45)	438	0	438	(483)
2068	0	(46)	(46)	443	0	443	(488)
2069	0	(46)	(46)	448	0	448	(494)
2070	0	(47)	(47)	452	0	452	(499)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Bethesda WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	131	0	0	0
1	2015	30,420	130	8	(20)	(28)
2	2016	31,090	130	16	(20)	(36)
3	2017	31,760	129	24	(21)	(45)
4	2018	32,429	128	33	(21)	(54)
5-year Goal	2019	33,099	128	42	(22)	(64)
6	2020	33,769	127	48	(22)	(70)
7	2021	34,327	127	54	(23)	(76)
8	2022	34,884	126	60	(23)	(83)
9	2023	35,442	126	66	(23)	(89)
10-year Goal	2024	35,999	126	72	(24)	(96)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Bethesda WSC's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	5.20	0	0	0
1	2015	30,420	5.36	(2)	(20)	(18)
2	2016	31,090	5.52	(4)	(20)	(17)
3	2017	31,760	5.68	(6)	(21)	(15)
4	2018	32,429	5.84	(8)	(21)	(14)
5-year Goal	2019	33,099	6.00	(10)	(22)	(12)
6	2020	33,769	6.00	(10)	(22)	(12)
7	2021	34,327	6.00	(10)	(23)	(13)
8	2022	34,884	6.00	(10)	(23)	(13)
9	2023	35,442	6.00	(10)	(23)	(13)
10-year Goal	2024	35,999	6.00	(11)	(24)	(13)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 20 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
        i. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	5.20	0
2015	30,420	7.00	(20)
2016	31,090	7.00	(20)
2017	31,760	7.00	(21)
2018	32,429	7.00	(21)
2019	33,099	7.00	(22)
2020	33,769	7.00	(22)
2021	34,327	7.00	(23)
2022	34,884	7.00	(23)
2023	35,442	7.00	(23)
2024	35,999	7.00	(24)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region G savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 121 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(20)	(20)	121	27	2	29	72
2017	0	(21)	(21)	123	27	2	30	73
2018	0	(21)	(21)	125	33	3	35	68
2019	0	(22)	(22)	126	38	3	41	63
2020	0	(22)	(22)	128	49	3	52	53
2021	0	(23)	(23)	129	59	3	62	44
2022	0	(23)	(23)	131	69	3	72	35
2023	0	(23)	(23)	132	79	3	82	26
2024	0	(24)	(24)	134	89	3	92	18
2025	0	(24)	(24)	135	99	3	102	9
2026	0	(24)	(24)	137	109	3	112	(0)
2027	0	(25)	(25)	138	119	3	122	(9)
2028	0	(25)	(25)	140	129	3	132	(18)
2029	0	(25)	(25)	141	139	3	142	(27)
2030	0	(26)	(26)	143	149	3	152	(36)
2031	0	(26)	(26)	144	161	3	164	(46)
2032	0	(27)	(27)	146	174	3	176	(57)
2033	0	(27)	(27)	147	186	2	188	(68)
2034	0	(28)	(28)	149	198	2	200	(79)
2035	0	(28)	(28)	151	211	2	212	(90)
2036	0	(28)	(28)	152	223	1	224	(100)
2037	0	(29)	(29)	154	235	1	236	(111)
2038	0	(29)	(29)	155	247	1	248	(122)
2039	0	(30)	(30)	157	260	0	260	(133)
2040	0	(30)	(30)	158	272	0	272	(144)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(20)	(20)	21	27	2	29	(28)
2017	0	(21)	(21)	22	27	2	30	(29)
2018	0	(21)	(21)	22	33	3	35	(35)
2019	0	(22)	(22)	22	38	3	41	(41)
2020	0	(22)	(22)	23	49	3	52	(52)
2021	0	(23)	(23)	23	59	3	62	(62)
2022	0	(23)	(23)	23	69	3	72	(72)
2023	0	(23)	(23)	23	79	3	82	(82)
2024	0	(24)	(24)	24	89	3	92	(92)
2025	0	(24)	(24)	24	99	3	102	(103)
2026	0	(24)	(24)	24	109	3	112	(113)
2027	0	(25)	(25)	24	119	3	122	(123)
2028	0	(25)	(25)	25	129	3	132	(133)
2029	0	(25)	(25)	25	139	3	142	(143)
2030	0	(26)	(26)	25	149	3	152	(153)
2031	0	(26)	(26)	25	161	3	164	(165)
2032	0	(27)	(27)	26	174	3	176	(177)
2033	0	(27)	(27)	26	186	2	188	(189)
2034	0	(28)	(28)	26	198	2	200	(201)
2035	0	(28)	(28)	27	211	2	212	(214)
2036	0	(28)	(28)	27	223	1	224	(226)
2037	0	(29)	(29)	27	235	1	236	(238)
2038	0	(29)	(29)	27	247	1	248	(250)
2039	0	(30)	(30)	28	260	0	260	(262)
2040	0	(30)	(30)	28	272	0	272	(274)

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 32 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(20)	(20)	32	27	2	29	(18)
2017	0	(21)	(21)	32	27	2	30	(18)
2018	0	(21)	(21)	33	33	3	35	(24)
2019	0	(22)	(22)	33	38	3	41	(30)
2020	0	(22)	(22)	34	49	3	52	(41)
2021	0	(23)	(23)	34	59	3	62	(51)
2022	0	(23)	(23)	34	69	3	72	(61)
2023	0	(23)	(23)	35	79	3	82	(71)
2024	0	(24)	(24)	35	89	3	92	(81)
2025	0	(24)	(24)	36	99	3	102	(91)
2026	0	(24)	(24)	36	109	3	112	(101)
2027	0	(25)	(25)	36	119	3	122	(111)
2028	0	(25)	(25)	37	129	3	132	(121)
2029	0	(25)	(25)	37	139	3	142	(131)
2030	0	(26)	(26)	38	149	3	152	(140)
2031	0	(26)	(26)	38	161	3	164	(152)
2032	0	(27)	(27)	38	174	3	176	(164)
2033	0	(27)	(27)	39	186	2	188	(176)
2034	0	(28)	(28)	39	198	2	200	(188)
2035	0	(28)	(28)	40	211	2	212	(200)
2036	0	(28)	(28)	40	223	1	224	(212)
2037	0	(29)	(29)	41	235	1	236	(224)
2038	0	(29)	(29)	41	247	1	248	(236)
2039	0	(30)	(30)	41	260	0	260	(248)
2040	0	(30)	(30)	42	272	0	272	(260)

4. Rain Barrels

   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Brenham Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Brenham's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Brenham's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Brenham's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Brenham with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	0	0	28	0	28	(28)
2016	0	0	0	34	0	34	(34)
2017	0	0	0	34	0	34	(34)
2018	0	0	0	41	0	41	(41)
2019	0	0	0	48	0	48	(48)
2020	0	0	0	62	0	62	(62)
2021	0	0	0	73	0	73	(73)
2022	0	0	0	84	0	84	(84)
2023	0	0	0	95	0	95	(95)
2024	0	0	0	106	0	106	(106)
2025	0	0	0	118	0	118	(118)
2026	0	0	0	129	0	129	(129)
2027	0	0	0	140	0	140	(140)
2028	0	0	0	151	0	151	(151)
2029	0	0	0	162	0	162	(162)
2030	0	0	0	173	0	173	(173)
2031	0	0	0	185	0	185	(185)
2032	0	0	0	196	0	196	(196)
2033	0	0	0	208	0	208	(208)
2034	0	0	0	220	0	220	(220)
2035	0	0	0	232	0	232	(232)
2036	0	0	0	243	0	243	(243)
2037	0	0	0	255	0	255	(255)
2038	0	0	0	267	0	267	(267)
2039	0	0	0	278	0	278	(278)
2040	0	0	0	290	0	290	(290)
2041	0	0	0	303	0	303	(303)
2042	0	0	0	315	0	315	(315)
2043	0	0	0	328	0	328	(328)
2044	0	0	0	340	0	340	(340)
2045	0	0	0	353	0	353	(353)
2046	0	0	0	365	0	365	(365)
2047	0	0	0	378	0	378	(378)
2048	0	0	0	390	0	390	(390)
2049	0	0	0	403	0	403	(403)
2050	0	0	0	415	0	415	(415)
2051	0	0	0	423	0	423	(423)
2052	0	0	0	430	0	430	(430)
2053	0	0	0	438	0	438	(438)
2054	0	0	0	445	0	445	(445)
2055	0	0	0	453	0	453	(453)
2056	0	0	0	461	0	461	(461)
2057	0	0	0	468	0	468	(468)
2058	0	0	0	476	0	476	(476)
2059	0	0	0	483	0	483	(483)
2060	0	0	0	491	0	491	(491)
2061	0	0	0	493	0	493	(493)
2062	0	0	0	494	0	494	(494)
2063	0	0	0	496	0	496	(496)
2064	0	0	0	497	0	497	(497)
2065	0	0	0	499	0	499	(499)
2066	0	0	0	500	0	500	(500)
2067	0	0	0	502	0	502	(502)
2068	0	0	0	503	0	503	(503)
2069	0	0	0	505	0	505	(505)
2070	0	0	0	506	0	506	(506)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Brenham's quantified savings from its implemented activities compare with 5- and 10- year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	182	0	0	0
1	2015	16,579	179	19	0	(19)
2	2016	16,734	176	39	0	(39)
3	2017	16,889	172	59	0	(59)
4	2018	17,045	169	80	0	(80)
5-year Goal	2019	17,200	166	100	0	(100)
6	2020	17,355	164	114	0	(114)
7	2021	17,508	162	128	0	(128)
8	2022	17,661	160	142	0	(142)
9	2023	17,814	158	156	0	(156)
10-year Goal	2024	17,967	156	171	0	(171)

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Brenham's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	16,579	10.00	0	0	0
2	2016	16,734	10.00	0	0	0
3	2017	16,889	10.00	0	0	0
4	2018	17,045	10.00	0	0	0
5-year Goal	2019	17,200	10.00	0	0	0
6	2020	17,355	9.80	1	0	(1)
7	2021	17,508	9.60	3	0	(3)
8	2022	17,661	9.40	4	0	(4)
9	2023	17,814	9.20	5	0	(5)
10-year Goal	2024	17,967	9.00	7	0	(7)

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.

- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 10 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	16,579	10.00	0
2016	16,734	10.00	0
2017	16,889	10.00	0
2018	17,045	10.00	0
2019	17,200	10.00	0
2020	17,355	10.00	0
2021	17,508	10.00	0
2022	17,661	10.00	0
2023	17,814	10.00	0
2024	17,967	10.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 6.95% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 90 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	90	34	0	34	55
2017	0	0	0	90	34	0	34	56
2018	0	0	0	91	41	0	41	50
2019	0	0	0	92	48	0	48	44
2020	0	0	0	92	62	0	62	30
2021	0	0	0	93	73	0	73	20
2022	0	0	0	94	84	0	84	9
2023	0	0	0	94	95	0	95	(1)
2024	0	0	0	95	106	0	106	(11)
2025	0	0	0	96	118	0	118	(22)
2026	0	0	0	96	129	0	129	(32)
2027	0	0	0	97	140	0	140	(43)
2028	0	0	0	97	151	0	151	(53)
2029	0	0	0	98	162	0	162	(64)
2030	0	0	0	99	173	0	173	(74)
2031	0	0	0	99	185	0	185	(86)
2032	0	0	0	100	196	0	196	(97)
2033	0	0	0	100	208	0	208	(108)
2034	0	0	0	100	220	0	220	(119)
2035	0	0	0	101	232	0	232	(131)
2036	0	0	0	101	243	0	243	(142)
2037	0	0	0	102	255	0	255	(153)
2038	0	0	0	102	267	0	267	(165)
2039	0	0	0	102	278	0	278	(176)
2040	0	0	0	103	290	0	290	(187)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	17	34	0	34	(17)
2017	0	0	0	17	34	0	34	(17)
2018	0	0	0	18	41	0	41	(24)
2019	0	0	0	18	48	0	48	(31)
2020	0	0	0	18	62	0	62	(44)
2021	0	0	0	18	73	0	73	(55)
2022	0	0	0	18	84	0	84	(66)
2023	0	0	0	18	95	0	95	(77)
2024	0	0	0	18	106	0	106	(88)
2025	0	0	0	18	118	0	118	(99)
2026	0	0	0	19	129	0	129	(110)
2027	0	0	0	19	140	0	140	(121)
2028	0	0	0	19	151	0	151	(132)
2029	0	0	0	19	162	0	162	(143)
2030	0	0	0	19	173	0	173	(154)
2031	0	0	0	19	185	0	185	(166)
2032	0	0	0	19	196	0	196	(177)
2033	0	0	0	19	208	0	208	(189)
2034	0	0	0	19	220	0	220	(200)
2035	0	0	0	19	232	0	232	(212)
2036	0	0	0	20	243	0	243	(224)
2037	0	0	0	20	255	0	255	(235)
2038	0	0	0	20	267	0	267	(247)
2039	0	0	0	20	278	0	278	(259)
2040	0	0	0	20	290	0	290	(270)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 26 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	26	34	0	34	(9)
2017	0	0	0	26	34	0	34	(8)
2018	0	0	0	26	41	0	41	(15)
2019	0	0	0	26	48	0	48	(22)
2020	0	0	0	27	62	0	62	(35)
2021	0	0	0	27	73	0	73	(46)
2022	0	0	0	27	84	0	84	(57)
2023	0	0	0	27	95	0	95	(68)
2024	0	0	0	27	106	0	106	(79)
2025	0	0	0	27	118	0	118	(90)
2026	0	0	0	28	129	0	129	(101)
2027	0	0	0	28	140	0	140	(112)
2028	0	0	0	28	151	0	151	(123)
2029	0	0	0	28	162	0	162	(134)
2030	0	0	0	28	173	0	173	(145)
2031	0	0	0	29	185	0	185	(156)
2032	0	0	0	29	196	0	196	(168)
2033	0	0	0	29	208	0	208	(179)
2034	0	0	0	29	220	0	220	(191)
2035	0	0	0	29	232	0	232	(202)
2036	0	0	0	29	243	0	243	(214)
2037	0	0	0	29	255	0	255	(226)
2038	0	0	0	29	267	0	267	(237)
2039	0	0	0	29	278	0	278	(249)
2040	0	0	0	30	290	0	290	(260)

4. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Brushy Creek MUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Brushy Creek MUD's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Brushy Creek MUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Brushy Creek MUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Brushy Creek MUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	45	45	34	0	34	10
2016	0	43	43	43	0	43	1
2017	0	42	42	43	0	43	-0
2018	0	41	41	51	0	51	(10)
2019	0	40	40	60	0	60	(20)
2020	0	39	39	77	0	77	(38)
2021	0	39	39	91	0	91	(52)
2022	0	39	39	105	0	105	(66)
2023	0	40	40	119	0	119	(80)
2024	0	40	40	133	0	133	(93)
2025	0	40	40	148	0	148	(107)
2026	0	41	41	162	0	162	(121)
2027	0	41	41	176	0	176	(135)
2028	0	41	41	190	0	190	(149)
2029	0	42	42	204	0	204	(163)
2030	0	42	42	218	0	218	(176)
2031	0	42	42	231	0	231	(189)
2032	0	42	42	244	0	244	(202)
2033	0	42	42	256	0	256	(214)
2034	0	42	42	269	0	269	(227)
2035	0	42	42	282	0	282	(240)
2036	0	42	42	294	0	294	(252)
2037	0	42	42	307	0	307	(265)
2038	0	42	42	320	0	320	(277)
2039	0	42	42	332	0	332	(290)
2040	0	42	42	345	0	345	(303)
2041	0	42	42	357	0	357	(314)
2042	0	42	42	368	0	368	(326)
2043	0	42	42	380	0	380	(338)
2044	0	42	42	392	0	392	(350)
2045	0	42	42	403	0	403	(361)
2046	0	42	42	415	0	415	(373)
2047	0	42	42	427	0	427	(385)
2048	0	42	42	438	0	438	(396)
2049	0	42	42	450	0	450	(408)
2050	0	42	42	462	0	462	(420)
2051	0	42	42	473	0	473	(431)
2052	0	42	42	484	0	484	(442)
2053	0	42	42	495	0	495	(453)
2054	0	42	42	505	0	505	(463)
2055	0	42	42	516	0	516	(474)
2056	0	42	42	527	0	527	(485)
2057	0	42	42	538	0	538	(496)
2058	0	42	42	549	0	549	(507)
2059	0	42	42	560	0	560	(518)
2060	0	42	42	571	0	571	(529)
2061	0	42	42	581	0	581	(539)
2062	0	42	42	591	0	591	(549)
2063	0	42	42	600	0	600	(558)
2064	0	42	42	610	0	610	(568)
2065	0	42	42	620	0	620	(578)
2066	0	42	42	630	0	630	(588)
2067	0	42	42	640	0	640	(598)
2068	0	42	42	649	0	649	(607)
2069	0	42	42	659	0	659	(617)
2070	0	42	42	669	0	669	(627)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Brushy Creek MUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	166	0	0	0
1	2015	20,387	162	31	46	15
2	2016	20,810	158	64	45	(19)
3	2017	21,232	153	98	44	(54)
4	2018	21,655	149	133	43	(90)
5-year Goal	2019	22,077	145	169	41	(128)
6	2020	22,500	144	181	40	(140)
7	2021	22,550	143	189	41	(149)
8	2022	22,600	142	198	41	(157)
9	2023	22,650	141	207	41	(165)
10-year Goal	2024	22,700	140	215	42	(174)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Brushy Creek MUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	29.00	0	0.0	0
1	2015	20,387	27.20	13	44.6	31
2	2016	20,810	25.40	27	43.4	16
3	2017	21,232	23.60	42	42.2	0
4	2018	21,655	21.80	57	41.0	(16)
5-year Goal	2019	22,077	20.00	73	39.8	(33)
6	2020	22,500	19.00	82	38.6	(44)
7	2021	22,550	18.00	91	39.0	(52)
8	2022	22,600	17.00	99	39.3	(60)
9	2023	22,650	16.00	107	39.6	(68)
10-year Goal	2024	22,700	15.00	116	40.0	(76)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 45 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	29.00	0
2015	20,387	23.00	45
2016	19,837	23.00	43
2017	19,287	23.00	42
2018	18,736	23.00	41
2019	18,186	23.00	40
2020	17,636	23.00	39
2021	17,792	23.00	39
2022	17,948	23.00	39
2023	18,105	23.00	40
2024	18,261	23.00	40

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region G savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 105 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	43	43	105	43	0	43	105
2017	0	42	42	105	43	0	43	105
2018	0	41	41	106	51	0	51	96
2019	0	40	40	107	60	0	60	87
2020	0	39	39	108	77	0	77	70
2021	0	39	39	109	91	0	91	57
2022	0	39	39	109	105	0	105	44
2023	0	40	40	110	119	0	119	31
2024	0	40	40	111	133	0	133	18
2025	0	40	40	112	148	0	148	5
2026	0	41	41	113	162	0	162	(8)
2027	0	41	41	114	176	0	176	(21)
2028	0	41	41	114	190	0	190	(34)
2029	0	42	42	115	204	0	204	(47)
2030	0	42	42	116	218	0	218	(60)
2031	0	42	42	116	231	0	231	(73)
2032	0	42	42	116	244	0	244	(86)
2033	0	42	42	116	256	0	256	(99)
2034	0	42	42	116	269	0	269	(111)
2035	0	42	42	116	282	0	282	(124)
2036	0	42	42	115	294	0	294	(137)
2037	0	42	42	115	307	0	307	(149)
2038	0	42	42	115	320	0	320	(162)
2039	0	42	42	115	332	0	332	(175)
2040	0	42	42	115	345	0	345	(188)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. **Current Savings + Potential Savings from AMI with Customer Portal (MG).**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	43	43	18	43	0	43	19
2017	0	42	42	19	43	0	43	18
2018	0	41	41	19	51	0	51	9
2019	0	40	40	19	60	0	60	(1)
2020	0	39	39	19	77	0	77	(19)
2021	0	39	39	19	91	0	91	(33)
2022	0	39	39	19	105	0	105	(47)
2023	0	40	40	19	119	0	119	(60)
2024	0	40	40	20	133	0	133	(74)
2025	0	40	40	20	148	0	148	(88)
2026	0	41	41	20	162	0	162	(101)
2027	0	41	41	20	176	0	176	(115)
2028	0	41	41	20	190	0	190	(128)
2029	0	42	42	20	204	0	204	(142)
2030	0	42	42	20	218	0	218	(156)
2031	0	42	42	20	231	0	231	(168)
2032	0	42	42	20	244	0	244	(181)
2033	0	42	42	20	256	0	256	(194)
2034	0	42	42	20	269	0	269	(206)
2035	0	42	42	20	282	0	282	(219)
2036	0	42	42	20	294	0	294	(232)
2037	0	42	42	20	307	0	307	(244)
2038	0	42	42	20	320	0	320	(257)
2039	0	42	42	20	332	0	332	(270)
2040	0	42	42	20	345	0	345	(282)

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 28 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	43	43	28	43	0	43	28
2017	0	42	42	28	43	0	43	27
2018	0	41	41	28	51	0	51	18
2019	0	40	40	28	60	0	60	8
2020	0	39	39	28	77	0	77	(10)
2021	0	39	39	29	91	0	91	(23)
2022	0	39	39	29	105	0	105	(37)
2023	0	40	40	29	119	0	119	(51)
2024	0	40	40	29	133	0	133	(64)
2025	0	40	40	30	148	0	148	(78)
2026	0	41	41	30	162	0	162	(91)
2027	0	41	41	30	176	0	176	(105)
2028	0	41	41	30	190	0	190	(119)
2029	0	42	42	30	204	0	204	(132)
2030	0	42	42	31	218	0	218	(146)
2031	0	42	42	31	231	0	231	(158)
2032	0	42	42	31	244	0	244	(171)
2033	0	42	42	31	256	0	256	(184)
2034	0	42	42	31	269	0	269	(196)
2035	0	42	42	30	282	0	282	(209)
2036	0	42	42	30	294	0	294	(222)
2037	0	42	42	30	307	0	307	(234)
2038	0	42	42	30	320	0	320	(247)
2039	0	42	42	30	332	0	332	(260)
2040	0	42	42	30	345	0	345	(272)

4. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Bryan Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Bryan's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Bryan's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Bryan's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Bryan with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	132	180	312	71	0	71	241
2016	131	183	314	89	0	89	224
2017	130	185	315	89	0	89	226
2018	129	188	317	107	0	107	210
2019	128	191	319	125	0	125	194
2020	128	194	322	161	0	161	161
2021	128	195	323	196	0	196	127
2022	129	196	325	231	0	231	94
2023	129	197	326	266	0	266	60
2024	130	198	328	301	0	301	26
2025	130	199	329	337	0	337	(7)
2026	131	200	331	372	0	372	(41)
2027	131	202	333	407	0	407	(75)
2028	131	203	334	442	0	442	(108)
2029	132	204	336	477	0	477	(142)
2030	132	205	337	513	0	513	(175)
2031	136	211	346	514	0	514	(168)
2032	139	216	355	515	0	515	(160)
2033	142	222	364	517	0	517	(153)
2034	146	228	373	518	0	518	(145)
2035	149	233	382	520	0	520	(137)
2036	152	239	391	521	0	521	(130)
2037	156	245	400	522	0	522	(122)
2038	159	250	409	524	0	524	(115)
2039	162	256	418	525	0	525	(107)
2040	166	262	427	527	0	527	(99)
2041	168	266	434	529	0	529	(95)
2042	171	270	441	532	0	532	(91)
2043	173	274	448	535	0	535	(87)
2044	176	279	455	537	0	537	(83)
2045	179	283	462	540	0	540	(78)
2046	181	287	468	542	0	542	(74)
2047	184	292	475	545	0	545	(70)
2048	186	296	482	548	0	548	(66)
2049	189	300	489	550	0	550	(61)
2050	191	304	496	553	0	553	(57)
2051	194	309	503	560	0	560	(57)
2052	197	313	510	566	0	566	(56)
2053	200	318	518	573	0	573	(55)
2054	203	322	525	579	0	579	(54)
2055	205	327	532	586	0	586	(54)
2056	208	331	540	593	0	593	(53)
2057	211	336	547	599	0	599	(52)
2058	214	340	554	606	0	606	(51)
2059	217	345	562	612	0	612	(51)
2060	219	349	569	619	0	619	(50)
2061	222	354	577	627	0	627	(50)
2062	225	359	585	635	0	635	(50)
2063	228	364	593	643	0	643	(50)
2064	232	369	600	651	0	651	(50)
2065	235	374	608	659	0	659	(50)
2066	238	379	616	667	0	667	(50)
2067	241	384	624	675	0	675	(50)
2068	244	388	632	682	0	682	(50)
2069	247	393	640	690	0	690	(50)
2070	250	398	648	698	0	698	(51)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Bryan's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	82,118	148	60	312	252
2	2016	83,381	146	122	314	192
3	2017	84,644	144	185	315	130
4	2018	85,908	142	251	317	66
5-year Goal	2019	87,171	140	318	319	1
6	2020	88,434	139	368	322	(46)
7	2021	88,945	137	416	323	(92)
8	2022	89,456	136	464	325	(139)
9	2023	89,967	134	512	326	(186)
10-year Goal	2024	90,478	133	561	328	(234)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Bryan's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	82,118	14.20	24	180	156
2	2016	83,381	13.40	49	183	134
3	2017	84,644	12.60	74	185	111
4	2018	85,908	11.80	100	188	88
5-year Goal	2019	87,171	11.00	127	191	64
6	2020	88,434	11.00	129	194	65
7	2021	88,945	11.00	130	195	65
8	2022	89,456	11.00	131	196	65
9	2023	89,967	11.00	131	197	66
10-year Goal	2024	90,478	11.00	132	198	66

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 180 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. WaterWise Take-home Kits

a. Estimated savings of 7,384 gallons per year per kit (Frontier, 2015)
b. Conservative 5-year useful life for all items in kit
c. 15% adoption rate assumed

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Conservation Pricing	WaterWise Take-home Kits	TOTAL SAVINGS
2009				0
2010	0.01			0
2011	0.03			0
2012	0.04			0
2013	0.05		2.44	2
2014	0.06	125.2	4.50	130
2015	0.08	125.6	6.49	132
2016	0.09	126.1	4.90	131
2017	0.09	126.5	3.30	130
2018	0.09	127.0	1.71	129
2019	0.09	127.4	0.60	128
2020	0.08	127.9		128
2021	0.06	128.3		128
2022	0.05	128.8		129
2023	0.04	129.2		129
2024	0.03	129.7		130
2025	0.01	130.1		130
2026		130.6		131
2027		131.0		131
2028		131.5		131
2029		131.9		132
2030		132.4		132
2031		135.7		136
2032		139.1		139
2033		142.4		142
2034		145.7		146
2035		149.1		149
2036		152.4		152
2037		155.7		156
2038		159.1		159
2039		162.4		162
2040		165.7		166
2041		168.3		168
2042		170.9		171
2043		173.4		173
2044		176.0		176
2045		178.6		179
2046		181.1		181
2047		183.7		184
2048		186.3		186
2049		188.8		189
2050		191.4		191
2051		194.2		194
2052		197.0		197
2053		199.8		200
2054		202.6		203
2055		205.4		205
2056		208.2		208
2057		211.0		211
2058		213.8		214
2059		216.6		217
2060		219.4		219
2061		222.4		222
2062		225.5		225
2063		228.5		228
2064		231.5		232
2065		234.6		235
2066		237.6		238
2067		240.6		241
2068		243.7		244
2069		246.7		247
2070		249.7		250

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	82,118	9.00	180
2016	83,381	9.00	183
2017	84,644	9.00	185
2018	85,908	9.00	188
2019	87,171	9.00	191
2020	88,434	9.00	194
2021	88,945	9.00	195
2022	89,456	9.00	196
2023	89,967	9.00	197
2024	90,478	9.00	198

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region G savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 382 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	131	183	314	382	89	0	89	607
2017	130	185	315	384	89	0	89	610
2018	129	188	317	385	107	0	107	595
2019	128	191	319	386	125	0	125	580
2020	128	194	322	388	161	0	161	549
2021	128	195	323	389	196	0	196	516
2022	129	196	325	390	231	0	231	484
2023	129	197	326	392	266	0	266	452
2024	130	198	328	393	301	0	301	420
2025	130	199	329	395	337	0	337	387
2026	131	200	331	396	372	0	372	355
2027	131	202	333	397	407	0	407	323
2028	131	203	334	399	442	0	442	291
2029	132	204	336	400	477	0	477	258
2030	132	205	337	401	513	0	513	226
2031	136	211	346	412	514	0	514	244
2032	139	216	355	422	515	0	515	261
2033	142	222	364	432	517	0	517	279
2034	146	228	373	442	518	0	518	297
2035	149	233	382	452	520	0	520	315
2036	152	239	391	462	521	0	521	332
2037	156	245	400	472	522	0	522	350
2038	159	250	409	482	524	0	524	368
2039	162	256	418	492	525	0	525	385
2040	166	262	427	503	527	0	527	403

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	131	183	314	68	89	0	89	292
2017	130	185	315	68	89	0	89	294
2018	129	188	317	68	107	0	107	278
2019	128	191	319	68	125	0	125	262
2020	128	194	322	69	161	0	161	230
2021	128	195	323	69	196	0	196	196
2022	129	196	325	69	231	0	231	163
2023	129	197	326	69	266	0	266	129
2024	130	198	328	70	301	0	301	96
2025	130	199	329	70	337	0	337	63
2026	131	200	331	70	372	0	372	29
2027	131	202	333	70	407	0	407	(4)
2028	131	203	334	70	442	0	442	(38)
2029	132	204	336	71	477	0	477	(71)
2030	132	205	337	71	513	0	513	(104)
2031	136	211	346	73	514	0	514	(95)
2032	139	216	355	75	515	0	515	(86)
2033	142	222	364	76	517	0	517	(76)
2034	146	228	373	78	518	0	518	(67)
2035	149	233	382	80	520	0	520	(58)
2036	152	239	391	82	521	0	521	(48)
2037	156	245	400	83	522	0	522	(39)
2038	159	250	409	85	524	0	524	(29)
2039	162	256	418	87	525	0	525	(20)
2040	166	262	427	89	527	0	527	(11)

3. Water Rate Increase

- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 101 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	131	183	314	101	89	0	89	325
2017	130	185	315	101	89	0	89	327
2018	129	188	317	102	107	0	107	311
2019	128	191	319	102	125	0	125	296
2020	128	194	322	102	161	0	161	263
2021	128	195	323	103	196	0	196	230
2022	129	196	325	103	231	0	231	197
2023	129	197	326	103	266	0	266	163
2024	130	198	328	104	301	0	301	130
2025	130	199	329	104	337	0	337	97
2026	131	200	331	104	372	0	372	64
2027	131	202	333	105	407	0	407	30
2028	131	203	334	105	442	0	442	(3)
2029	132	204	336	106	477	0	477	(36)
2030	132	205	337	106	513	0	513	(69)
2031	136	211	346	109	514	0	514	(59)
2032	139	216	355	111	515	0	515	(49)
2033	142	222	364	114	517	0	517	(39)
2034	146	228	373	117	518	0	518	(28)
2035	149	233	382	119	520	0	520	(18)
2036	152	239	391	122	521	0	521	(8)
2037	156	245	400	125	522	0	522	2
2038	159	250	409	127	524	0	524	13
2039	162	256	418	130	525	0	525	23
2040	166	262	427	133	527	0	527	33

Statewide Water Conservation Quantification Project
City of Burleson Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Burleson's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Burleson's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Burleson's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Burleson with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	165	175	340	1	1	2	338
2016	173	175	349	1	1	2	347
2017	176	175	352	1	2	2	350
2018	179	176	355	1	2	3	352
2019	182	176	358	1	2	3	355
2020	185	176	361	1	2	4	357
2021	188	179	367	1	2	4	363
2022	191	182	373	2	2	4	369
2023	194	186	379	2	2	4	375
2024	197	189	386	2	2	4	381
2025	200	192	392	2	2	4	387
2026	203	195	398	2	2	5	393
2027	206	198	404	2	2	5	399
2028	208	202	410	3	2	5	405
2029	211	205	416	3	2	5	411
2030	214	208	422	3	2	5	417
2031	217	211	429	3	2	5	423
2032	220	215	435	3	2	6	430
2033	223	218	441	4	2	6	436
2034	227	221	448	4	2	6	442
2035	230	225	454	4	2	6	448
2036	233	228	460	4	2	6	454
2037	236	231	467	4	2	7	460
2038	239	234	473	4	2	7	466
2039	242	238	480	5	2	7	473
2040	245	241	486	5	2	7	479
2041	248	244	493	5	2	8	485
2042	252	248	499	6	2	8	491
2043	255	251	506	6	2	8	498
2044	258	255	513	6	2	9	504
2045	262	258	520	7	2	9	511
2046	265	262	527	7	2	10	517
2047	268	265	533	8	2	10	524
2048	272	269	540	8	2	10	530
2049	275	272	547	8	2	11	536
2050	278	276	554	9	2	11	543
2051	282	279	561	9	2	12	550
2052	285	283	568	10	2	12	556
2053	289	287	576	10	2	12	563
2054	293	290	583	11	2	13	570
2055	296	294	590	11	2	13	577
2056	300	297	597	12	2	14	583
2057	303	301	605	12	2	14	590
2058	307	305	612	12	2	15	597
2059	311	308	619	13	2	15	604
2060	314	312	626	13	2	16	611
2061	318	316	634	14	2	16	618
2062	322	320	642	14	2	17	625
2063	326	323	649	15	2	17	632
2064	330	327	657	15	2	17	639
2065	333	331	664	16	2	18	646
2066	337	335	672	16	2	18	654
2067	341	339	680	17	2	19	661
2068	345	342	687	17	2	19	668
2069	349	346	695	17	2	20	675
2070	352	350	702	18	2	20	682

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Burleson's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	133	0	0	0
1	2015	43,625	132	22	340	317
2	2016	43,660	130	45	349	304
3	2017	43,695	129	67	352	285
4	2018	43,731	127	89	355	265
5-year Goal	2019	43,766	126	112	358	246
6	2020	43,801	125	122	361	239
7	2021	44,605	125	134	367	234
8	2022	45,410	124	146	373	227
9	2023	46,214	124	159	379	221
10-year Goal	2024	47,019	123	172	386	214

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Burleson's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	43,625	15.00	0	175	175
2	2016	43,660	15.00	0	175	175
3	2017	43,695	15.00	0	175	175
4	2018	43,731	15.00	0	176	176
5-year Goal	2019	43,766	15.00	0	176	176
6	2020	43,801	15.00	0	176	176
7	2021	44,605	15.00	0	179	179
8	2022	45,410	15.00	0	182	182
9	2023	46,214	15.00	0	186	186
10-year Goal	2024	47,019	15.00	0	189	189

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 175 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3.75% increase in 2015
        ii. 1.0% increase in 2016
    b. Estimated customer demand reduction of 1.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.58% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015) All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	2x Watering Ordinance	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014		148	148
2015	13.9	151	165
2016	20.2	153	173
2017	20.6	156	176
2018	20.9	158	179
2019	21.2	161	182
2020	21.6	164	185
2021	21.9	166	188
2022	22.3	169	191
2023	22.6	171	194
2024	22.9	174	197
2025	23.3	176	200
2026	23.6	179	203
2027	24.0	182	206
2028	24.3	184	208
2029	24.6	187	211
2030	25.0	189	214
2031	25.3	192	217
2032	25.7	195	220
2033	26.0	197	223
2034	26.4	200	227
2035	26.8	203	230
2036	27.1	206	233
2037	27.5	208	236
2038	27.8	211	239
2039	28.2	214	242
2040	28.5	216	245
2041	28.9	219	248
2042	29.3	222	252
2043	29.7	225	255
2044	30.1	228	258
2045	30.5	231	262
2046	30.9	234	265
2047	31.3	237	268
2048	31.6	240	272
2049	32.0	243	275
2050	32.4	246	278
2051	32.8	249	282
2052	33.3	252	285
2053	33.7	255	289
2054	34.1	259	293
2055	34.5	262	296
2056	35.0	265	300
2057	35.4	268	303
2058	35.8	271	307
2059	36.2	274	311
2060	36.6	278	314
2061	37.1	281	318
2062	37.5	284	322
2063	38.0	288	326
2064	38.4	291	330
2065	38.9	294	333
2066	39.3	298	337
2067	39.7	301	341
2068	40.2	305	345
2069	40.6	308	349
2070	41.1	311	352

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	43,625	4.00	175
2016	43,660	4.00	175
2017	43,695	4.00	175
2018	43,731	4.00	176
2019	43,766	4.00	176
2020	43,801	4.00	176
2021	44,605	4.00	179
2022	45,410	4.00	182
2023	46,214	4.00	186
2024	47,019	4.00	189

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	173	175	349	27	1	1	2	374
2017	176	175	352	28	1	2	2	377
2018	179	176	355	28	1	2	3	380
2019	182	176	358	28	1	2	3	383
2020	185	176	361	29	1	2	4	386
2021	188	179	367	29	1	2	4	393
2022	191	182	373	30	2	2	4	399
2023	194	186	379	30	2	2	4	406
2024	197	189	386	31	2	2	4	412
2025	200	192	392	31	2	2	4	419
2026	203	195	398	32	2	2	5	425
2027	206	198	404	32	2	2	5	431
2028	208	202	410	33	3	2	5	438
2029	211	205	416	33	3	2	5	444
2030	214	208	422	33	3	2	5	451
2031	217	211	429	34	3	2	5	457
2032	220	215	435	34	3	2	6	464
2033	223	218	441	35	4	2	6	471
2034	227	221	448	35	4	2	6	477
2035	230	225	454	36	4	2	6	484
2036	233	228	460	36	4	2	6	490
2037	236	231	467	37	4	2	7	497
2038	239	234	473	37	4	2	7	504
2039	242	238	480	38	5	2	7	510
2040	245	241	486	38	5	2	7	517

2. Rain Barrels

a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Cedar Park Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Cedar Park's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Cedar Park's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Cedar Park's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Cedar Park with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year #	Year	Utility Population	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
4	2015	65,945	397	144	542	127	0	127	415
5	2016	68,970	403	151	554	158	0	158	396
6	2017	71,995	491	158	649	158	0	158	490
7	2018	75,019	495	164	660	190	0	190	469
8	2019	78,044	499	171	670	222	0	222	448
9	2020	81,069	503	178	681	285	0	285	396
10	2021	81,914	508	179	687	341	0	341	347
11	2022	82,759	513	181	694	396	0	396	298
12	2023	83,603	518	183	701	451	0	451	250
13	2024	84,448	522	185	707	507	0	507	200
14	2025	85,293	527	187	714	562	0	562	152
15	2026	86,138	532	189	720	617	0	617	103
16	2027	86,983	536	190	727	673	0	673	54
17	2028	87,827	541	192	734	728	0	728	6
18	2029	88,672	546	194	740	783	0	783	(43)
19	2030	89,517	551	196	747	839	0	839	(92)
20	2031	89,594	551	196	747	884	0	884	(137)
21	2032	89,671	552	196	748	930	0	930	(182)
22	2033	89,748	552	197	748	976	0	976	(228)
23	2034	89,825	552	197	749	1,022	0	1,022	(273)
24	2035	89,902	552	197	749	1,068	0	1,068	(319)
25	2036	89,979	553	197	750	1,114	0	1,114	(364)
26	2037	90,056	553	197	750	1,160	0	1,160	(410)
27	2038	90,133	553	197	751	1,206	0	1,206	(455)
28	2039	90,210	554	198	751	1,252	0	1,252	(501)
29	2040	90,287	554	198	752	1,298	0	1,298	(546)
30	2041	90,287	554	198	752	1,313	0	1,313	(561)
31	2042	90,287	554	198	752	1,327	0	1,327	(576)
32	2043	90,287	554	198	751	1,342	0	1,342	(591)
33	2044	90,287	554	198	751	1,357	0	1,357	(606)
34	2045	90,287	554	198	751	1,372	0	1,372	(621)
35	2046	90,287	553	198	751	1,387	0	1,387	(636)
36	2047	90,287	553	198	751	1,402	0	1,402	(651)
37	2048	90,287	553	198	751	1,417	0	1,417	(666)
38	2049	90,287	553	198	751	1,431	0	1,431	(681)
39	2050	90,287	553	198	751	1,446	0	1,446	(696)
40	2051	90,287	553	198	751	1,449	0	1,449	(698)
41	2052	90,287	553	198	751	1,452	0	1,452	(701)
42	2053	90,287	553	198	751	1,455	0	1,455	(704)
43	2054	90,287	553	198	751	1,457	0	1,457	(707)
44	2055	90,287	553	198	751	1,460	0	1,460	(709)
45	2056	90,287	553	198	751	1,463	0	1,463	(712)
46	2057	90,287	553	198	750	1,466	0	1,466	(715)
47	2058	90,287	553	198	750	1,468	0	1,468	(718)
48	2059	90,287	553	198	750	1,471	0	1,471	(721)
49	2060	90,287	553	198	750	1,474	0	1,474	(723)
50	2061	90,287	553	198	750	1,477	0	1,477	(726)
51	2062	90,287	553	198	750	1,480	0	1,480	(729)
52	2063	90,287	553	198	750	1,483	0	1,483	(732)
53	2064	90,287	553	198	750	1,486	0	1,486	(735)
54	2065	90,287	553	198	750	1,489	0	1,489	(738)
55	2066	90,287	552	198	750	1,492	0	1,492	(741)
56	2067	90,287	552	198	750	1,495	0	1,495	(745)
57	2068	90,287	552	198	750	1,498	0	1,498	(748)
58	2069	90,287	552	198	750	1,501	0	1,501	(751)
59	2070	90,287	552	198	750	1,504	0	1,504	(754)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Cedar Park's quantified savings from its implemented activities compare with 5- and 10- year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	169	0	0	0
1	2015	65,945	167	43	542	499
2	2016	68,970	165	91	554	464
3	2017	71,995	164	142	649	507
4	2018	75,019	162	197	660	462
5-year Goal	2019	78,044	160	256	670	414
6	2020	81,069	159	290	681	391
7	2021	81,914	158	317	687	370
8	2022	82,759	158	344	694	350
9	2023	83,603	157	372	701	328
10-year Goal	2024	84,448	156	401	707	306

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Cedar Park's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	29.00	0	0	0
1	2015	65,945	27.60	34	144	111
2	2016	68,970	26.20	70	151	81
3	2017	71,995	24.80	110	158	47
4	2018	75,019	23.40	153	164	11
5-year Goal	2019	78,044	22.00	199	171	(28)
6	2020	81,069	21.80	213	178	(36)
7	2021	81,914	21.60	221	179	(42)
8	2022	82,759	21.40	230	181	(48)
9	2023	83,603	21.20	238	183	(55)
10-year Goal	2024	84,448	21.00	247	185	(62)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 144 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**
    a. "You're running the sH2Ow"
    b. Implemented in 2017
    c. Estimated savings of 84.6 MG in 2017
        i. Specific utility results may vary based on portal features and notifications
    d. Assumes 20% of residential customers are using and saving water due to the portal (Westin Engineering, 2015)
    e. Assumes customers save 10% of total annual use due to the portal
        i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
    f. Residential customers' use makes up approximately 78% of all retail customers' use based on utility profile information submitted to the TWDB
    g. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.56% of total demand
    h. Savings are assumed to increase along with demand as connections increase each year[17]

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.37% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

6. **Outdoor Landscape Evaluations (SF)**
    a. 468 outdoor evaluations performed since 2014
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
        i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. **Rainwater Harvesting**
    a. In Region G, estimated savings of 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels and systems

8. **Showerhead Distribution (SF)**
    a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
    b. 5-year useful life
        i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Rain Barrels	AMI with Customer Portal	Outdoor Audits	Low-flow Showerhead Rebate	TOTAL SAVINGS
2011	377				0.4	377
2012	381				0.7	382
2013	385				1.1	386
2014	389	0.43		0.6	1.8	392
2015	393	0.43		1.9	2.3	397
2016	397	0.43		3.2	2.8	403
2017	401	0.43	84.6	2.5	2.8	491
2018	405	0.43	85.5	1.7	2.8	495
2019	409	0.43	86.3	1.0	2.8	499
2020	413	0.43	87.1	0.4	2.8	503
2021	417	0.43	88.0		2.8	508
2022	421	0.43	88.8		2.8	513
2023	425	0.43	89.7		2.8	518
2024	429		90.5		2.8	522
2025	433		91.3		2.8	527
2026	437		92.2		2.8	532
2027	441		93.0		2.8	536
2028	445		93.9		2.8	541
2029	449		94.7		2.8	546
2030	453		95.5		2.8	551
2031	453		95.6		2.8	551
2032	453		95.7		2.8	552
2033	453		95.7		2.8	552
2034	454		95.8		2.8	552
2035	454		95.8		2.8	552
2036	454		95.9		2.8	553
2037	454		95.9		2.8	553
2038	455		96.0		2.8	553
2039	455		96.0		2.8	554
2040	455		96.1		2.8	554
2041	455		96.1		2.8	554
2042	455		96.1		2.8	554
2043	455		96.0		2.8	554
2044	455		96.0		2.8	554
2045	455		96.0		2.8	554
2046	455		96.0		2.8	553
2047	455		96.0		2.8	553
2048	455		96.0		2.8	553
2049	454		95.9		2.8	553
2050	454		95.9		2.8	553
2051	454		95.9		2.8	553
2052	454		95.9		2.8	553
2053	454		95.9		2.8	553
2054	454		95.9		2.8	553
2055	454		95.9		2.8	553
2056	454		95.9		2.8	553
2057	454		95.9		2.8	553
2058	454		95.9		2.8	553
2059	454		95.9		2.8	553
2060	454		95.8		2.8	553
2061	454		95.8		2.8	553
2062	454		95.8		2.8	553
2063	454		95.8		2.8	553
2064	454		95.8		2.8	553
2065	454		95.8		2.8	553
2066	454		95.8		2.8	552
2067	454		95.8		2.8	552
2068	454		95.8		2.8	552
2069	454		95.8		2.8	552
2070	454		95.8		2.8	552

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	29.00	0
2015	65,945	23.00	144
2016	68,970	23.00	151
2017	71,995	23.00	158
2018	75,019	23.00	164
2019	78,044	23.00	171
2020	81,069	23.00	178
2021	81,914	23.00	179
2022	82,759	23.00	181
2023	83,603	23.00	183
2024	84,448	23.00	185

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 108 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-1 for potential savings from this measure compared with the utility's conservation goals.

Table 6-1. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	403	151	554	397	158	0	158	793
2017	491	158	649	401	158	0	158	891
2018	495	164	660	405	190	0	190	874
2019	499	171	670	409	222	0	222	857
2020	503	178	681	413	285	0	285	809
2021	508	179	687	417	341	0	341	764
2022	513	181	694	421	396	0	396	719
2023	518	183	701	425	451	0	451	674
2024	522	185	707	429	507	0	507	629
2025	527	187	714	433	562	0	562	584
2026	532	189	720	437	617	0	617	540
2027	536	190	727	441	673	0	673	495
2028	541	192	734	445	728	0	728	450
2029	546	194	740	449	783	0	783	406
2030	551	196	747	453	839	0	839	361
2031	551	196	747	453	884	0	884	316
2032	552	196	748	453	930	0	930	271
2033	552	197	748	453	976	0	976	225
2034	552	197	749	454	1,022	0	1,022	180
2035	552	197	749	454	1,068	0	1,068	135
2036	553	197	750	454	1,114	0	1,114	90
2037	553	197	750	454	1,160	0	1,160	45
2038	553	197	751	455	1,206	0	1,206	(0)
2039	554	198	751	455	1,252	0	1,252	(46)
2040	554	198	752	455	1,298	0	1,298	(91)

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of College Station Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares College Station's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) College Station's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in College Station's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for College Station with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	14.2	236	250	98	0	98	152
2016	17.3	234	251	123	0	123	128
2017	16.5	231	248	123	0	123	125
2018	15.8	229	245	148	0	148	97
2019	15.3	226	241	172	0	172	69
2020	14.9	224	239	221	0	221	17
2021	14.7	230	245	283	0	283	(38)
2022	14.6	237	252	346	0	346	(94)
2023	14.6	244	258	408	0	408	(149)
2024	14.5	250	265	470	0	470	(205)
2025	14.5	257	272	532	0	532	(260)
2026	14.5	264	278	594	0	594	(316)
2027	14.5	271	285	656	0	656	(371)
2028	14.5	277	292	718	0	718	(426)
2029	14.5	284	298	780	0	780	(482)
2030	14.5	291	305	842	0	842	(537)
2031	14.5	293	307	871	0	871	(564)
2032	14.5	295	309	900	0	900	(591)
2033	14.5	297	311	928	0	928	(617)
2034	14.5	299	313	957	0	957	(644)
2035	14.5	301	315	986	0	986	(671)
2036	14.5	303	317	1,015	0	1,015	(697)
2037	14.5	305	319	1,043	0	1,043	(724)
2038	14.5	307	321	1,072	0	1,072	(751)
2039	14.5	309	323	1,101	0	1,101	(777)
2040	14.5	311	325	1,129	0	1,129	(804)
2041	14.5	316	330	1,141	0	1,141	(811)
2042	14.5	321	335	1,153	0	1,153	(817)
2043	14.5	326	340	1,164	0	1,164	(824)
2044	14.5	331	345	1,176	0	1,176	(831)
2045	14.5	336	350	1,188	0	1,188	(838)
2046	14.5	340	355	1,199	0	1,199	(844)
2047	14.5	345	360	1,211	0	1,211	(851)
2048	14.5	350	365	1,223	0	1,223	(858)
2049	14.5	355	370	1,234	0	1,234	(864)
2050	14.5	360	375	1,246	0	1,246	(871)
2051	14.5	366	380	1,263	0	1,263	(882)
2052	14.5	371	385	1,279	0	1,279	(894)
2053	14.5	376	391	1,296	0	1,296	(905)
2054	14.5	381	396	1,312	0	1,312	(916)
2055	14.5	387	401	1,329	0	1,329	(928)
2056	14.5	392	407	1,345	0	1,345	(939)
2057	14.5	397	412	1,362	0	1,362	(950)
2058	14.5	403	417	1,379	0	1,379	(961)
2059	14.5	408	423	1,395	0	1,395	(973)
2060	14.5	413	428	1,412	0	1,412	(984)
2061	14.5	419	434	1,431	0	1,431	(997)
2062	14.5	425	440	1,451	0	1,451	(1,011)
2063	14.5	431	445	1,470	0	1,470	(1,024)
2064	14.5	437	451	1,489	0	1,489	(1,038)
2065	14.5	443	457	1,509	0	1,509	(1,051)
2066	14.5	449	463	1,528	0	1,528	(1,065)
2067	14.5	454	469	1,547	0	1,547	(1,078)
2068	14.5	460	475	1,567	0	1,567	(1,092)
2069	14.5	466	481	1,586	0	1,586	(1,105)
2070	14.5	472	487	1,605	0	1,605	(1,119)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how College Station's quantified savings from its implemented activities compare with 5- and 10- year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	157	0	0	0
1	2015	107,889	155	79	250	172
2	2016	106,739	153	156	251	95
3	2017	105,589	151	231	248	16
4	2018	104,440	149	305	245	(60)
5-year Goal	2019	103,290	147	377	241	(136)
6	2020	102,140	146	425	239	(186)
7	2021	105,195	144	491	245	(246)
8	2022	108,250	143	561	252	(309)
9	2023	111,305	141	634	258	(375)
10-year Goal	2024	114,360	140	710	265	(445)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how College Station's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2015	107,889	8.80	8	236	228
2	2016	106,739	8.60	16	234	218
3	2017	105,589	8.40	23	231	208
4	2018	104,440	8.20	30	229	198
5-year Goal	2019	103,290	8.00	38	226	189
6	2020	102,140	8.00	37	224	186
7	2021	105,195	8.00	38	230	192
8	2022	108,250	8.00	40	237	198
9	2023	111,305	8.00	41	244	203
10-year Goal	2024	114,360	8.00	42	250	209

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 236 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Outdoor Landscape Evaluations**
    a. 726 outdoor evaluations performed since 2010
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
        i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5. **Rainwater Harvesting**
    a. In Region G, estimated savings of 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels and systems

6. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    b. Savings carry on indefinitely because replacement toilet will be as efficient

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

7. **HE Toilet Replacement Program (MF)**
    a. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    b. 20-year useful life for fixture[17]
    c. Savings carry on indefinitely because replacement toilet will be as efficient

8. **HE Toilet Replacement Program (ICI)**
    a. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
    b. 20-year useful life for fixture

[17] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Outdoor Water Audits	HE Toilets (MF/ICI)	HE Toilets (SF)	TOTAL SAVINGS
2009					0
2010	0.01	0.80	1.0	0.2	2.0
2011	0.03	1.44	8.3	0.4	10.2
2012	0.10	1.92	8.3	0.7	11.1
2013	0.13	2.24	9.8	1.1	13.3
2014	0.15	2.40	9.8	1.4	13.8
2015	0.16	2.40	9.8	1.8	14.2
2016	0.18	2.61	12.6	1.9	17.3
2017	0.18	1.77	12.6	1.9	16.5
2018	0.18	1.08	12.6	1.9	15.8
2019	0.18	0.56	12.6	1.9	15.3
2020	0.16	0.20	12.6	1.9	14.9
2021	0.15		12.6	1.9	14.7
2022	0.08		12.6	1.9	14.6
2023	0.05		12.6	1.9	14.6
2024	0.03		12.6	1.9	14.5
2025	0.01		12.6	1.9	14.5
2026			12.6	1.9	14.5
2027			12.6	1.9	14.5
2028			12.6	1.9	14.5
2029			12.6	1.9	14.5
2030			12.6	1.9	14.5
2031			12.6	1.9	14.5
2032			12.6	1.9	14.5
2033			12.6	1.9	14.5
2034			12.6	1.9	14.5
2035			12.6	1.9	14.5
2036			12.6	1.9	14.5
2037			12.6	1.9	14.5
2038			12.6	1.9	14.5
2039			12.6	1.9	14.5
2040			12.6	1.9	14.5
2041			12.6	1.9	14.5
2042			12.6	1.9	14.5
2043			12.6	1.9	14.5
2044			12.6	1.9	14.5
2045			12.6	1.9	14.5
2046			12.6	1.9	14.5
2047			12.6	1.9	14.5
2048			12.6	1.9	14.5
2049			12.6	1.9	14.5
2050			12.6	1.9	14.5
2051			12.6	1.9	14.5
2052			12.6	1.9	14.5
2053			12.6	1.9	14.5
2054			12.6	1.9	14.5
2055			12.6	1.9	14.5
2056			12.6	1.9	14.5
2057			12.6	1.9	14.5
2058			12.6	1.9	14.5
2059			12.6	1.9	14.5
2060			12.6	1.9	14.5
2061			12.6	1.9	14.5
2062			12.6	1.9	14.5
2063			12.6	1.9	14.5
2064			12.6	1.9	14.5
2065			12.6	1.9	14.5
2066			12.6	1.9	14.5
2067			12.6	1.9	14.5
2068			12.6	1.9	14.5
2069			12.6	1.9	14.5
2070			12.6	1.9	14.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	107,889	3.00	236
2016	106,739	3.00	234
2017	105,589	3.00	231
2018	104,440	3.00	229
2019	103,290	3.00	226
2020	102,140	3.00	224
2021	105,195	3.00	230
2022	108,250	3.00	237
2023	111,305	3.00	244
2024	114,360	3.00	250

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 6.95% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 388 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	234	251	388	123	0	123	516
2017	16	231	248	399	123	0	123	524
2018	16	229	245	411	148	0	148	508
2019	15	226	241	423	172	0	172	492
2020	15	224	239	434	221	0	221	452
2021	15	230	245	446	283	0	283	408
2022	15	237	252	458	346	0	346	364
2023	15	244	258	469	408	0	408	320
2024	15	250	265	481	470	0	470	276
2025	15	257	272	493	532	0	532	232
2026	15	264	278	504	594	0	594	189
2027	15	271	285	516	656	0	656	145
2028	15	277	292	528	718	0	718	101
2029	15	284	298	539	780	0	780	57
2030	15	291	305	551	842	0	842	14
2031	15	293	307	554	871	0	871	(10)
2032	15	295	309	557	900	0	900	(33)
2033	15	297	311	560	928	0	928	(57)
2034	15	299	313	564	957	0	957	(80)
2035	15	301	315	567	986	0	986	(104)
2036	15	303	317	570	1,015	0	1,015	(127)
2037	15	305	319	573	1,043	0	1,043	(151)
2038	15	307	321	576	1,072	0	1,072	(174)
2039	15	309	323	580	1,101	0	1,101	(198)
2040	15	311	325	583	1,129	0	1,129	(221)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	234	251	75	123	0	123	203
2017	16	231	248	77	123	0	123	202
2018	16	229	245	79	148	0	148	176
2019	15	226	241	82	172	0	172	151
2020	15	224	239	84	221	0	221	101
2021	15	230	245	86	283	0	283	48
2022	15	237	252	88	346	0	346	(6)
2023	15	244	258	90	408	0	408	(59)
2024	15	250	265	93	470	0	470	(112)
2025	15	257	272	95	532	0	532	(165)
2026	15	264	278	97	594	0	594	(218)
2027	15	271	285	99	656	0	656	(272)
2028	15	277	292	102	718	0	718	(325)
2029	15	284	298	104	780	0	780	(378)
2030	15	291	305	106	842	0	842	(431)
2031	15	293	307	107	871	0	871	(457)
2032	15	295	309	107	900	0	900	(483)
2033	15	297	311	108	928	0	928	(509)
2034	15	299	313	109	957	0	957	(535)
2035	15	301	315	109	986	0	986	(561)
2036	15	303	317	110	1,015	0	1,015	(587)
2037	15	305	319	111	1,043	0	1,043	(613)
2038	15	307	321	111	1,072	0	1,072	(639)
2039	15	309	323	112	1,101	0	1,101	(665)
2040	15	311	325	112	1,129	0	1,129	(692)

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 112 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	234	251	112	123	0	123	240
2017	16	231	248	115	123	0	123	240
2018	16	229	245	118	148	0	148	215
2019	15	226	241	122	172	0	172	191
2020	15	224	239	125	221	0	221	142
2021	15	230	245	128	283	0	283	90
2022	15	237	252	132	346	0	346	38
2023	15	244	258	135	408	0	408	(14)
2024	15	250	265	138	470	0	470	(66)
2025	15	257	272	142	532	0	532	(118)
2026	15	264	278	145	594	0	594	(171)
2027	15	271	285	148	656	0	656	(223)
2028	15	277	292	152	718	0	718	(275)
2029	15	284	298	155	780	0	780	(327)
2030	15	291	305	159	842	0	842	(379)
2031	15	293	307	159	871	0	871	(405)
2032	15	295	309	160	900	0	900	(430)
2033	15	297	311	161	928	0	928	(456)
2034	15	299	313	162	957	0	957	(482)
2035	15	301	315	163	986	0	986	(507)
2036	15	303	317	164	1,015	0	1,015	(533)
2037	15	305	319	165	1,043	0	1,043	(559)
2038	15	307	321	166	1,072	0	1,072	(585)
2039	15	309	323	167	1,101	0	1,101	(610)
2040	15	311	325	168	1,129	0	1,129	(636)

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Georgetown Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Georgetown's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Georgetown's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Georgetown's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Georgetown with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	85	450	535	137	0	137	398
2016	89	462	551	171	0	171	380
2017	91	474	565	171	0	171	394
2018	93	487	580	205	0	205	375
2019	95	499	594	239	0	239	355
2020	97	512	609	307	0	307	301
2021	99	525	624	383	0	383	241
2022	102	538	639	458	0	458	181
2023	104	551	655	533	0	533	121
2024	106	564	670	609	0	609	61
2025	108	577	685	684	0	684	1
2026	109	590	700	759	0	759	(60)
2027	112	603	715	835	0	835	(120)
2028	114	616	730	910	0	910	(179)
2029	116	630	746	985	0	985	(239)
2030	119	643	761	1,060	0	1,060	(299)
2031	121	659	780	1,154	0	1,154	(374)
2032	124	675	800	1,248	0	1,248	(448)
2033	127	692	819	1,342	0	1,342	(523)
2034	130	708	838	1,435	0	1,435	(597)
2035	133	724	857	1,529	0	1,529	(672)
2036	136	741	876	1,623	0	1,623	(746)
2037	139	757	896	1,716	0	1,716	(821)
2038	142	773	915	1,810	0	1,810	(895)
2039	144	790	934	1,904	0	1,904	(970)
2040	147	806	953	1,997	0	1,997	(1,044)
2041	150	823	974	2,120	0	2,120	(1,146)
2042	154	841	995	2,243	0	2,243	(1,248)
2043	157	859	1,015	2,365	0	2,365	(1,350)
2044	160	876	1,036	2,488	0	2,488	(1,452)
2045	163	894	1,057	2,611	0	2,611	(1,554)
2046	166	911	1,077	2,733	0	2,733	(1,656)
2047	169	929	1,098	2,856	0	2,856	(1,758)
2048	172	947	1,119	2,979	0	2,979	(1,860)
2049	176	964	1,140	3,101	0	3,101	(1,962)
2050	179	982	1,160	3,224	0	3,224	(2,063)
2051	182	1,002	1,184	3,305	0	3,305	(2,121)
2052	186	1,022	1,207	3,387	0	3,387	(2,179)
2053	189	1,041	1,231	3,468	0	3,468	(2,237)
2054	193	1,061	1,254	3,550	0	3,550	(2,295)
2055	197	1,081	1,278	3,631	0	3,631	(2,353)
2056	200	1,101	1,301	3,713	0	3,713	(2,411)
2057	204	1,121	1,325	3,794	0	3,794	(2,469)
2058	207	1,141	1,348	3,876	0	3,876	(2,527)
2059	211	1,161	1,372	3,957	0	3,957	(2,585)
2060	214	1,181	1,395	4,039	0	4,039	(2,643)
2061	218	1,202	1,420	4,128	0	4,128	(2,708)
2062	222	1,222	1,444	4,217	0	4,217	(2,773)
2063	225	1,243	1,468	4,306	0	4,306	(2,838)
2064	229	1,263	1,493	4,395	0	4,395	(2,903)
2065	233	1,284	1,517	4,485	0	4,485	(2,968)
2066	236	1,305	1,541	4,574	0	4,574	(3,033)
2067	240	1,325	1,565	4,663	0	4,663	(3,097)
2068	244	1,346	1,590	4,752	0	4,752	(3,162)
2069	248	1,367	1,614	4,841	0	4,841	(3,227)
2070	251	1,387	1,638	4,931	0	4,931	(3,292)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Georgetown's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	218	0	0	0
1	2015	87,091	210	242	535	293
2	2016	89,591	203	497	551	54
3	2017	92,090	195	766	565	(201)
4	2018	94,590	188	1,050	580	(470)
5-year Goal	2019	97,089	180	1,347	594	(752)
6	2020	99,589	176	1,527	609	(918)
7	2021	102,110	172	1,714	624	(1,090)
8	2022	104,631	168	1,910	639	(1,270)
9	2023	107,151	164	2,112	655	(1,457)
10-year Goal	2024	109,672	160	2,322	670	(1,652)

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Georgetown's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	45.00	0	0	0
1	2015	87,091	42.60	76	450	373
2	2016	89,591	40.20	157	462	305
3	2017	92,090	37.80	242	474	232
4	2018	94,590	35.40	331	487	155
5-year Goal	2019	97,089	33.00	425	499	74
6	2020	99,589	32.00	473	512	39
7	2021	102,110	31.00	522	525	3
8	2022	104,631	30.00	573	538	(35)
9	2023	107,151	29.00	626	551	(75)
10-year Goal	2024	109,672	28.00	681	564	(117)

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.

- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 450 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 7.0% increase in 2014

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.

b. Estimated customer demand reduction of 1.4%
c. Savings are cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 4, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 5 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.
    d. Savings were not estimated for any customer engagement associated with Georgetown Utilities Analysis and Reporting Doorway (GUARD)
        i. For this report, it was uncertain what features, notifications, and frequency of communication with customers were in place, making savings difficult to estimate as a result.

6. **Outdoor Landscape Evaluations (SF)**
    a. 288 outdoor evaluations performed since 2015
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. **Rain Barrels**
    a. Approximately 1,080 65-gallon barrels distributed since 2014
    b. In Region G, estimated savings of 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002)
        i. Estimated 10-year useful life for most barrels

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Water Rate Increase	Outdoor Audits	TOTAL SAVINGS
2012				0
2013				0
2014	0.4	82		82
2015	0.9	84	0.27	85
2016	1.3	87	0.81	89
2017	1.3	89	0.64	91
2018	1.3	91	0.46	93
2019	1.3	93	0.29	95
2020	1.3	96	0.12	97
2021	1.3	98		99
2022	1.3	100		102
2023	1.3	103		104
2024	0.9	105		106
2025	0.4	107		108
2026		109		109
2027		112		112
2028		114		114
2029		116		116
2030		119		119
2031		121		121
2032		124		124
2033		127		127
2034		130		130
2035		133		133
2036		136		136
2037		139		139
2038		142		142
2039		144		144
2040		147		147
2041		150		150
2042		154		154
2043		157		157
2044		160		160
2045		163		163
2046		166		166
2047		169		169
2048		172		172
2049		176		176
2050		179		179
2051		182		182
2052		186		186
2053		189		189
2054		193		193
2055		197		197
2056		200		200
2057		204		204
2058		207		207
2059		211		211
2060		214		214
2061		218		218
2062		222		222
2063		225		225
2064		229		229
2065		233		233
2066		236		236
2067		240		240
2068		244		244
2069		248		248
2070		251		251

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	45.00	0
2015	63,716	25.67	450
2016	65,474	25.67	462
2017	67,232	25.67	474
2018	68,991	25.67	487
2019	70,749	25.67	499
2020	72,507	25.67	512
2021	74,365	25.67	525
2022	76,223	25.67	538
2023	78,080	25.67	551
2024	79,938	25.67	564

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region G savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 469 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG)

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	89	462	551	469	171	0	171	849
2017	91	474	565	481	171	0	171	876
2018	93	487	580	494	205	0	205	868
2019	95	499	594	506	239	0	239	861
2020	97	512	609	518	307	0	307	820
2021	99	525	624	531	383	0	383	772
2022	102	538	639	543	458	0	458	724
2023	104	551	655	555	533	0	533	677
2024	106	564	670	568	609	0	609	629
2025	108	577	685	580	684	0	684	581
2026	109	590	700	592	759	0	759	533
2027	112	603	715	605	835	0	835	485
2028	114	616	730	617	910	0	910	437
2029	116	630	746	629	985	0	985	390
2030	119	643	761	642	1,060	0	1,060	342
2031	121	659	780	657	1,154	0	1,154	283
2032	124	675	800	673	1,248	0	1,248	225
2033	127	692	819	688	1,342	0	1,342	166
2034	130	708	838	704	1,435	0	1,435	107
2035	133	724	857	720	1,529	0	1,529	48
2036	136	741	876	735	1,623	0	1,623	(11)
2037	139	757	896	751	1,716	0	1,716	(70)
2038	142	773	915	767	1,810	0	1,810	(129)
2039	144	790	934	782	1,904	0	1,904	(187)
2040	147	806	953	798	1,997	0	1,997	(246)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	89	462	551	83	171	0	171	463
2017	91	474	565	85	171	0	171	480
2018	93	487	580	87	205	0	205	462
2019	95	499	594	89	239	0	239	445
2020	97	512	609	92	307	0	307	393
2021	99	525	624	94	383	0	383	335
2022	102	538	639	96	458	0	458	277
2023	104	551	655	98	533	0	533	220
2024	106	564	670	100	609	0	609	161
2025	108	577	685	103	684	0	684	103
2026	109	590	700	105	759	0	759	45
2027	112	603	715	107	835	0	835	(13)
2028	114	616	730	109	910	0	910	(70)
2029	116	630	746	111	985	0	985	(128)
2030	119	643	761	113	1,060	0	1,060	(186)
2031	121	659	780	116	1,154	0	1,154	(258)
2032	124	675	800	119	1,248	0	1,248	(329)
2033	127	692	819	122	1,342	0	1,342	(401)
2034	130	708	838	124	1,435	0	1,435	(473)
2035	133	724	857	127	1,529	0	1,529	(545)
2036	136	741	876	130	1,623	0	1,623	(616)
2037	139	757	896	133	1,716	0	1,716	(688)
2038	142	773	915	136	1,810	0	1,810	(760)
2039	144	790	934	138	1,904	0	1,904	(831)
2040	147	806	953	141	1,997	0	1,997	(903)

TWDB Statewide Water Conservation Quantification Project
City of Groesbeck Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Groesbeck's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Groesbeck's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Groesbeck's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Groesbeck with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	14	21	34	0	0	0	34
2016	14	21	34	0	0	0	34
2017	14	21	34	0	0	0	34
2018	13	21	34	0	0	0	34
2019	13	21	34	0	0	0	34
2020	13	21	34	1	0	1	34
2021	13	21	34	1	0	1	34
2022	13	21	34	1	0	1	34
2023	13	21	34	0	0	0	34
2024	13	21	34	0	0	0	34
2025	13	21	34	0	0	0	34
2026	13	21	34	0	0	0	34
2027	13	21	34	0	0	0	34
2028	13	21	34	0	0	0	34
2029	13	21	34	0	0	0	34
2030	13	21	34	0	0	0	34
2031	13	21	34	0	0	0	34
2032	13	21	34	0	0	0	34
2033	13	21	34	0	0	0	34
2034	13	21	34	0	0	0	34
2035	13	21	34	0	0	0	34
2036	13	21	34	0	0	0	34
2037	13	21	34	0	0	0	34
2038	13	21	34	0	0	0	34
2039	13	21	34	0	0	0	34
2040	13	21	34	0	0	0	34
2041	13	21	34	0	0	0	34
2042	13	21	34	0	0	0	34
2043	13	21	34	0	0	0	34
2044	13	21	34	0	0	0	34
2045	13	21	34	0	0	0	34
2046	13	21	34	0	0	0	34
2047	13	21	34	0	0	0	34
2048	13	21	34	0	0	0	34
2049	13	21	34	0	0	0	34
2050	13	21	34	0	0	0	34
2051	13	21	34	0	0	0	34
2052	13	21	34	0	0	0	34
2053	13	21	34	0	0	0	34
2054	13	21	34	0	0	0	34
2055	13	21	34	0	0	0	34
2056	13	21	34	0	0	0	34
2057	13	21	34	0	0	0	34
2058	13	21	34	0	0	0	34
2059	13	21	34	0	0	0	34
2060	13	21	35	0	0	0	35
2061	13	21	35	0	0	0	35
2062	13	21	35	0	0	0	35
2063	13	21	35	0	0	0	35
2064	13	21	35	0	0	0	35
2065	13	22	35	0	0	0	35
2066	13	22	35	0	0	0	35
2067	13	22	35	0	0	0	35
2068	13	22	35	0	0	0	35
2069	13	22	35	0	0	0	35
2070	13	22	35	0	0	0	35

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Groesbeck's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	157	0	0	0
1	2015	4,366	150	12	34	22
2	2016	4,368	142	24	34	11
3	2017	4,370	135	35	34	(1)
4	2018	4,373	127	47	34	(13)
5-year Goal	2019	4,375	120	59	34	(25)
6	2020	4,377	119	61	34	(26)
7	2021	4,381	118	62	34	(28)
8	2022	4,385	117	64	34	(30)
9	2023	4,390	116	66	34	(31)
10-year Goal	2024	4,394	115	67	34	(33)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Groesbeck's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	23.00	0	0	0
1	2015	4,366	22.00	2	21	19
2	2016	4,368	21.00	3	21	18
3	2017	4,370	20.00	5	21	16
4	2018	4,373	19.00	6	21	14
5-year Goal	2019	4,375	18.00	8	21	13
6	2020	4,377	17.00	10	21	11
7	2021	4,381	16.00	11	21	10
8	2022	4,385	15.00	13	21	8
9	2023	4,390	14.00	14	21	6
10-year Goal	2024	4,394	13.00	16	21	5

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 21 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 30% increase in 2014
    b. Estimated customer demand reduction of 6.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 4, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 5 of this report.
d. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	13.6	14
2015	13.6	14
2016	13.5	14
2017	13.5	14
2018	13.5	13
2019	13.5	13
2020	13.5	13
2021	13.4	13
2022	13.4	13
2023	13.4	13
2024	13.4	13
2025	13.3	13
2026	13.3	13
2027	13.3	13
2028	13.3	13
2029	13.3	13
2030	13.2	13
2031	13.2	13
2032	13.2	13
2033	13.2	13
2034	13.2	13
2035	13.2	13
2036	13.1	13
2037	13.1	13
2038	13.1	13
2039	13.1	13
2040	13.1	13
2041	13.1	13
2042	13.1	13
2043	13.0	13
2044	13.0	13
2045	13.0	13
2046	13.0	13
2047	13.0	13
2048	13.0	13
2049	13.0	13
2050	13.0	13
2051	13.0	13
2052	13.0	13
2053	13.0	13
2054	13.0	13
2055	13.0	13
2056	13.0	13
2057	13.0	13
2058	13.1	13
2059	13.1	13
2060	13.1	13
2061	13.1	13
2062	13.1	13
2063	13.1	13
2064	13.1	13
2065	13.1	13
2066	13.1	13
2067	13.1	13
2068	13.1	13
2069	13.1	13
2070	13.1	13

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	23.00	0
2015	4,366	10.00	21
2016	4,368	10.00	21
2017	4,370	10.00	21
2018	4,373	10.00	21
2019	4,375	10.00	21
2020	4,377	10.00	21
2021	4,381	10.00	21
2022	4,385	10.00	21
2023	4,390	10.00	21
2024	4,394	10.00	21

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    i. Average Region G savings
    ii. Specific percentage of outdoor usage unknown for your utility at this time
  b. Savings could be 17 MG per year with current demand.
  c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	14	21	34	17	0	0	0	51
2017	14	21	34	17	0	0	0	51
2018	13	21	34	17	0	0	0	51
2019	13	21	34	17	0	0	0	51
2020	13	21	34	17	1	0	1	51
2021	13	21	34	17	1	0	1	51
2022	13	21	34	17	1	0	1	51
2023	13	21	34	17	0	0	0	51
2024	13	21	34	17	0	0	0	51
2025	13	21	34	17	0	0	0	51
2026	13	21	34	17	0	0	0	51
2027	13	21	34	17	0	0	0	51
2028	13	21	34	17	0	0	0	51
2029	13	21	34	17	0	0	0	51
2030	13	21	34	17	0	0	0	51
2031	13	21	34	17	0	0	0	51
2032	13	21	34	17	0	0	0	51
2033	13	21	34	17	0	0	0	51
2034	13	21	34	17	0	0	0	51
2035	13	21	34	17	0	0	0	51
2036	13	21	34	17	0	0	0	51
2037	13	21	34	17	0	0	0	51
2038	13	21	34	17	0	0	0	51
2039	13	21	34	17	0	0	0	51
2040	13	21	34	17	0	0	0	51

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	14	21	34	3	0	0	0	37
2017	14	21	34	3	0	0	0	37
2018	13	21	34	3	0	0	0	37
2019	13	21	34	3	0	0	0	37
2020	13	21	34	3	1	0	1	37
2021	13	21	34	3	1	0	1	37
2022	13	21	34	3	1	0	1	37
2023	13	21	34	3	0	0	0	37
2024	13	21	34	3	0	0	0	37
2025	13	21	34	3	0	0	0	37
2026	13	21	34	3	0	0	0	37
2027	13	21	34	3	0	0	0	37
2028	13	21	34	3	0	0	0	37
2029	13	21	34	3	0	0	0	37
2030	13	21	34	3	0	0	0	37
2031	13	21	34	3	0	0	0	37
2032	13	21	34	3	0	0	0	37
2033	13	21	34	3	0	0	0	37
2034	13	21	34	3	0	0	0	37
2035	13	21	34	3	0	0	0	37
2036	13	21	34	3	0	0	0	37
2037	13	21	34	3	0	0	0	37
2038	13	21	34	3	0	0	0	37
2039	13	21	34	3	0	0	0	37
2040	13	21	34	3	0	0	0	37

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Hewitt Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Hewitt's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Hewitt's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Hewitt's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Hewitt with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	19	52	71	3	0	3	68
2016	19	53	72	4	0	4	68
2017	20	54	73	4	0	4	70
2018	20	55	75	5	0	5	70
2019	20	56	76	6	0	6	70
2020	20	57	77	7	0	7	70
2021	21	58	78	8	0	8	71
2022	21	58	79	8	0	8	71
2023	21	59	80	8	0	8	72
2024	21	60	81	9	0	9	73
2025	22	61	82	9	0	9	73
2026	22	62	84	10	0	10	74
2027	22	63	85	10	0	10	75
2028	22	63	86	11	0	11	75
2029	23	64	87	11	0	11	76
2030	23	65	88	11	0	11	76
2031	23	66	89	11	0	11	77
2032	23	67	90	11	0	11	78
2033	23	67	91	11	0	11	79
2034	24	68	92	11	0	11	80
2035	24	69	93	11	0	11	81
2036	24	70	94	11	0	11	82
2037	24	70	95	11	0	11	83
2038	25	71	96	11	0	11	84
2039	25	72	97	11	0	11	85
2040	25	73	98	11	0	11	86
2041	25	73	99	11	0	11	87
2042	25	74	99	11	0	11	88
2043	26	75	100	11	0	11	89
2044	26	76	101	11	0	11	90
2045	26	76	102	11	0	11	91
2046	26	77	103	11	0	11	92
2047	27	78	104	11	0	11	93
2048	27	79	105	11	0	11	94
2049	27	79	106	11	0	11	95
2050	27	80	107	11	0	11	96
2051	28	81	108	11	0	11	97
2052	28	82	109	11	0	11	98
2053	28	82	110	11	0	11	99
2054	28	83	111	11	0	11	100
2055	29	84	112	11	0	11	101
2056	29	85	113	11	0	11	102
2057	29	85	114	11	0	11	103
2058	29	86	115	11	0	11	104
2059	30	87	116	11	0	11	105
2060	30	88	117	11	0	11	106
2061	30	88	118	11	0	11	107
2062	30	89	119	11	0	11	108
2063	31	90	120	11	0	11	109
2064	31	90	121	11	0	11	110
2065	31	91	122	11	0	11	111
2066	31	92	123	11	0	11	112
2067	32	93	124	11	0	11	113
2068	32	93	125	11	0	11	114
2069	32	94	126	11	0	11	115
2070	32	95	127	11	0	11	116

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Hewitt's quantified savings from its implemented activities compare with 5- and 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	127	0	0	0
1	2015	14,252	126	7	71	64
2	2016	14,510	124	15	72	57
3	2017	14,768	123	23	73	51
4	2018	15,027	121	31	75	44
5-year Goal	2019	15,285	120	39	76	37
6	2020	15,543	118	51	77	26
7	2021	15,774	116	63	78	15
8	2022	16,004	114	76	79	3
9	2023	16,235	112	89	80	(9)
10-year Goal	2024	16,465	110	102	81	(21)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Hewitt's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	14,252	20.80	(4)	52	56
2	2016	14,510	21.60	(8)	53	61
3	2017	14,768	22.40	(13)	54	67
4	2018	15,027	23.20	(18)	55	72
5-year Goal	2019	15,285	24.00	(22)	56	78
6	2020	15,543	23.60	(20)	57	77
7	2021	15,774	23.20	(18)	58	76
8	2022	16,004	22.80	(16)	58	75
9	2023	16,235	22.40	(14)	59	73
10-year Goal	2024	16,465	22.00	(12)	60	72

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 52 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 6.0% increase in 2014
        ii. 5.5% increase in 2015
    b. Estimated customer demand reduction of 2.3%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	9.8	9.8
2015	19.1	19.1
2016	19.3	19.3
2017	19.6	19.6
2018	19.8	19.8
2019	20.1	20.1
2020	20.3	20.3
2021	20.6	20.6
2022	20.8	20.8
2023	21.1	21.1
2024	21.3	21.3
2025	21.5	21.5
2026	21.8	21.8
2027	22.0	22.0
2028	22.3	22.3
2029	22.5	22.5
2030	22.8	22.8
2031	23.0	23.0
2032	23.2	23.2
2033	23.4	23.4
2034	23.6	23.6
2035	23.9	23.9
2036	24.1	24.1
2037	24.3	24.3
2038	24.5	24.5
2039	24.7	24.7
2040	25.0	25.0
2041	25.2	25.2
2042	25.4	25.4
2043	25.7	25.7
2044	25.9	25.9
2045	26.1	26.1
2046	26.4	26.4
2047	26.6	26.6
2048	26.8	26.8
2049	27.1	27.1
2050	27.3	27.3
2051	27.6	27.6
2052	27.8	27.8
2053	28.1	28.1
2054	28.3	28.3
2055	28.6	28.6
2056	28.8	28.8
2057	29.0	29.0
2058	29.3	29.3
2059	29.5	29.5
2060	29.8	29.8
2061	30.0	30.0
2062	30.3	30.3
2063	30.5	30.5
2064	30.8	30.8
2065	31.0	31.0
2066	31.3	31.3
2067	31.5	31.5
2068	31.8	31.8
2069	32.0	32.0
2070	32.3	32.3

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	14,252	10.00	52
2016	14,510	10.00	53
2017	14,768	10.00	54
2018	15,027	10.00	55
2019	15,285	10.00	56
2020	15,543	10.00	57
2021	15,774	10.00	58
2022	16,004	10.00	58
2023	16,235	10.00	59
2024	16,465	10.00	60

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region G savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 64 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	19	53	72	64	4	0	4	132
2017	20	54	73	65	4	0	4	134
2018	20	55	75	65	5	0	5	135
2019	20	56	76	66	6	0	6	136
2020	20	57	77	67	7	0	7	137
2021	21	58	78	68	8	0	8	138
2022	21	58	79	69	8	0	8	140
2023	21	59	80	69	8	0	8	141
2024	21	60	81	70	9	0	9	143
2025	22	61	82	71	9	0	9	144
2026	22	62	84	72	10	0	10	146
2027	22	63	85	73	10	0	10	147
2028	22	63	86	73	11	0	11	149
2029	23	64	87	74	11	0	11	150
2030	23	65	88	75	11	0	11	151
2031	23	66	89	76	11	0	11	153
2032	23	67	90	76	11	0	11	155
2033	23	67	91	77	11	0	11	157
2034	24	68	92	78	11	0	11	158
2035	24	69	93	79	11	0	11	160
2036	24	70	94	79	11	0	11	162
2037	24	70	95	80	11	0	11	163
2038	25	71	96	81	11	0	11	165
2039	25	72	97	82	11	0	11	167
2040	25	73	98	82	11	0	11	168

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	19	53	72	11	4	0	4	80
2017	20	54	73	11	4	0	4	81
2018	20	55	75	12	5	0	5	81
2019	20	56	76	12	6	0	6	82
2020	20	57	77	12	7	0	7	82
2021	21	58	78	12	8	0	8	83
2022	21	58	79	12	8	0	8	83
2023	21	59	80	12	8	0	8	84
2024	21	60	81	12	9	0	9	85
2025	22	61	82	13	9	0	9	86
2026	22	62	84	13	10	0	10	87
2027	22	63	85	13	10	0	10	87
2028	22	63	86	13	11	0	11	88
2029	23	64	87	13	11	0	11	89
2030	23	65	88	13	11	0	11	90
2031	23	66	89	13	11	0	11	91
2032	23	67	90	14	11	0	11	92
2033	23	67	91	14	11	0	11	93
2034	24	68	92	14	11	0	11	94
2035	24	69	93	14	11	0	11	95
2036	24	70	94	14	11	0	11	96
2037	24	70	95	14	11	0	11	97
2038	25	71	96	14	11	0	11	98
2039	25	72	97	14	11	0	11	100
2040	25	73	98	15	11	0	11	101

3. Rain Barrels
    a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Kempner WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Kempner WSC's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Kempner WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Kempner WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Kempner WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(62)	(62)	14	0	14	(76)
2016	0	(62)	(62)	18	0	18	(80)
2017	0	(62)	(62)	18	0	18	(80)
2018	0	(63)	(63)	22	0	22	(84)
2019	0	(63)	(63)	25	0	25	(88)
2020	0	(63)	(63)	33	0	33	(96)
2021	0	(64)	(64)	37	0	37	(101)
2022	0	(64)	(64)	42	0	42	(106)
2023	0	(64)	(64)	46	0	46	(110)
2024	0	(65)	(65)	51	0	51	(115)
2025	0	(65)	(65)	55	0	55	(120)
2026	0	(65)	(65)	60	0	60	(125)
2027	0	(65)	(65)	64	0	64	(130)
2028	0	(66)	(66)	69	0	69	(135)
2029	0	(66)	(66)	73	0	73	(139)
2030	0	(66)	(66)	78	0	78	(144)
2031	0	(67)	(67)	77	0	77	(144)
2032	0	(68)	(68)	77	0	77	(145)
2033	0	(68)	(68)	77	0	77	(145)
2034	0	(69)	(69)	76	0	76	(145)
2035	0	(70)	(70)	76	0	76	(145)
2036	0	(70)	(70)	75	0	75	(145)
2037	0	(71)	(71)	75	0	75	(146)
2038	0	(72)	(72)	74	0	74	(146)
2039	0	(72)	(72)	74	0	74	(146)
2040	0	(73)	(73)	73	0	73	(146)
2041	0	(74)	(74)	73	0	73	(147)
2042	0	(74)	(74)	73	0	73	(147)
2043	0	(75)	(75)	73	0	73	(148)
2044	0	(76)	(76)	73	0	73	(149)
2045	0	(76)	(76)	73	0	73	(149)
2046	0	(77)	(77)	73	0	73	(150)
2047	0	(78)	(78)	73	0	73	(150)
2048	0	(78)	(78)	73	0	73	(151)
2049	0	(79)	(79)	72	0	72	(151)
2050	0	(80)	(80)	72	0	72	(152)
2051	0	(80)	(80)	73	0	73	(153)
2052	0	(81)	(81)	73	0	73	(154)
2053	0	(81)	(81)	74	0	74	(155)
2054	0	(82)	(82)	74	0	74	(156)
2055	0	(83)	(83)	74	0	74	(157)
2056	0	(83)	(83)	75	0	75	(158)
2057	0	(84)	(84)	75	0	75	(159)
2058	0	(84)	(84)	75	0	75	(160)
2059	0	(85)	(85)	76	0	76	(161)
2060	0	(86)	(86)	76	0	76	(162)
2061	0	(86)	(86)	77	0	77	(163)
2062	0	(87)	(87)	77	0	77	(164)
2063	0	(87)	(87)	78	0	78	(165)
2064	0	(88)	(88)	78	0	78	(166)
2065	0	(89)	(89)	79	0	79	(167)
2066	0	(89)	(89)	79	0	79	(168)
2067	0	(90)	(90)	79	0	79	(169)
2068	0	(90)	(90)	80	0	80	(170)
2069	0	(91)	(91)	80	0	80	(171)
2070	0	(92)	(92)	81	0	81	(172)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Kempner WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	168	0	0	0
1	2015	15,363	166	11	(62)	(73)
2	2016	15,450	164	23	(62)	(85)
3	2017	15,538	162	34	(62)	(96)
4	2018	15,625	160	46	(63)	(108)
5-year Goal	2019	15,713	158	57	(63)	(120)
6	2020	15,800	156	67	(63)	(130)
7	2021	15,871	155	76	(64)	(140)
8	2022	15,943	153	86	(64)	(150)
9	2023	16,014	152	96	(64)	(160)
10-year Goal	2024	16,086	150	106	(65)	(170)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Kempner WSC's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	52.00	0	0	0
1	2015	15,363	47.60	25	(62)	(86)
2	2016	15,450	43.20	50	(62)	(112)
3	2017	15,538	38.80	75	(62)	(137)
4	2018	15,625	34.40	100	(63)	(163)
5-year Goal	2019	15,713	30.00	126	(63)	(189)
6	2020	15,800	28.80	134	(63)	(197)
7	2021	15,871	27.60	141	(64)	(205)
8	2022	15,943	26.40	149	(64)	(213)
9	2023	16,014	25.20	157	(64)	(221)
10-year Goal	2024	16,086	24.00	164	(65)	(229)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 62 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	52.00	0
2015	15,363	63.00	(62)
2016	15,450	63.00	(62)
2017	15,538	63.00	(62)
2018	15,625	63.00	(63)
2019	15,713	63.00	(63)
2020	15,800	63.00	(63)
2021	15,871	63.00	(64)
2022	15,943	63.00	(64)
2023	16,014	63.00	(64)
2024	16,086	63.00	(65)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

- The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region G savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 61 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(62)	(62)	61	18	0	18	(19)
2017	0	(62)	(62)	61	18	0	18	(19)
2018	0	(63)	(63)	62	22	0	22	(22)
2019	0	(63)	(63)	63	25	0	25	(26)
2020	0	(63)	(63)	63	33	0	33	(33)
2021	0	(64)	(64)	64	37	0	37	(37)
2022	0	(64)	(64)	65	42	0	42	(41)
2023	0	(64)	(64)	65	46	0	46	(45)
2024	0	(65)	(65)	66	51	0	51	(49)
2025	0	(65)	(65)	67	55	0	55	(53)
2026	0	(65)	(65)	67	60	0	60	(58)
2027	0	(65)	(65)	68	64	0	64	(62)
2028	0	(66)	(66)	69	69	0	69	(66)
2029	0	(66)	(66)	69	73	0	73	(70)
2030	0	(66)	(66)	70	78	0	78	(74)
2031	0	(67)	(67)	70	77	0	77	(74)
2032	0	(68)	(68)	71	77	0	77	(74)
2033	0	(68)	(68)	72	77	0	77	(73)
2034	0	(69)	(69)	72	76	0	76	(73)
2035	0	(70)	(70)	73	76	0	76	(72)
2036	0	(70)	(70)	74	75	0	75	(72)
2037	0	(71)	(71)	74	75	0	75	(72)
2038	0	(72)	(72)	75	74	0	74	(71)
2039	0	(72)	(72)	75	74	0	74	(71)
2040	0	(73)	(73)	76	73	0	73	(70)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(62)	(62)	11	18	0	18	(69)
2017	0	(62)	(62)	11	18	0	18	(70)
2018	0	(63)	(63)	11	22	0	22	(73)
2019	0	(63)	(63)	11	25	0	25	(77)
2020	0	(63)	(63)	11	33	0	33	(85)
2021	0	(64)	(64)	11	37	0	37	(90)
2022	0	(64)	(64)	11	42	0	42	(94)
2023	0	(64)	(64)	12	46	0	46	(99)
2024	0	(65)	(65)	12	51	0	51	(104)
2025	0	(65)	(65)	12	55	0	55	(108)
2026	0	(65)	(65)	12	60	0	60	(113)
2027	0	(65)	(65)	12	64	0	64	(118)
2028	0	(66)	(66)	12	69	0	69	(122)
2029	0	(66)	(66)	12	73	0	73	(127)
2030	0	(66)	(66)	12	78	0	78	(132)
2031	0	(67)	(67)	12	77	0	77	(132)
2032	0	(68)	(68)	13	77	0	77	(132)
2033	0	(68)	(68)	13	77	0	77	(132)
2034	0	(69)	(69)	13	76	0	76	(132)
2035	0	(70)	(70)	13	76	0	76	(132)
2036	0	(70)	(70)	13	75	0	75	(132)
2037	0	(71)	(71)	13	75	0	75	(133)
2038	0	(72)	(72)	13	74	0	74	(133)
2039	0	(72)	(72)	13	74	0	74	(133)
2040	0	(73)	(73)	13	73	0	73	(133)

3. Water Rate Increase
  a. For every 10% increase, estimated savings could be 2% of utility total demand.
  b. Approximately 16 MG of savings per year with current demand
  c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
  d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(62)	(62)	16	18	0	18	(64)
2017	0	(62)	(62)	16	18	0	18	(64)
2018	0	(63)	(63)	16	22	0	22	(68)
2019	0	(63)	(63)	17	25	0	25	(72)
2020	0	(63)	(63)	17	33	0	33	(79)
2021	0	(64)	(64)	17	37	0	37	(84)
2022	0	(64)	(64)	17	42	0	42	(89)
2023	0	(64)	(64)	17	46	0	46	(93)
2024	0	(65)	(65)	17	51	0	51	(98)
2025	0	(65)	(65)	18	55	0	55	(103)
2026	0	(65)	(65)	18	60	0	60	(107)
2027	0	(65)	(65)	18	64	0	64	(112)
2028	0	(66)	(66)	18	69	0	69	(116)
2029	0	(66)	(66)	18	73	0	73	(121)
2030	0	(66)	(66)	18	78	0	78	(126)
2031	0	(67)	(67)	19	77	0	77	(126)
2032	0	(68)	(68)	19	77	0	77	(126)
2033	0	(68)	(68)	19	77	0	77	(126)
2034	0	(69)	(69)	19	76	0	76	(126)
2035	0	(70)	(70)	19	76	0	76	(126)
2036	0	(70)	(70)	19	75	0	75	(126)
2037	0	(71)	(71)	20	75	0	75	(126)
2038	0	(72)	(72)	20	74	0	74	(126)
2039	0	(72)	(72)	20	74	0	74	(126)
2040	0	(73)	(73)	20	73	0	73	(126)

4. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Lampasas Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Lampasas' current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Lampasas' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Lampasas' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Lampasas with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	11.2	(76)	(65)	4	0	4	(68)
2016	11.3	(75)	(64)	5	0	5	(69)
2017	11.4	(75)	(63)	5	0	5	(68)
2018	11.5	(74)	(63)	6	0	6	(68)
2019	11.6	(74)	(62)	7	0	7	(69)
2020	11.7	(73)	(61)	9	0	9	(70)
2021	11.7	(74)	(62)	9	0	9	(71)
2022	11.8	(74)	(63)	9	0	9	(71)
2023	11.9	(75)	(63)	9	0	9	(72)
2024	12.0	(76)	(64)	9	0	9	(73)
2025	12.1	(77)	(65)	9	0	9	(74)
2026	12.2	(78)	(65)	9	0	9	(74)
2027	12.2	(78)	(66)	9	0	9	(75)
2028	12.3	(79)	(67)	9	0	9	(76)
2029	12.4	(80)	(67)	9	0	9	(76)
2030	12.5	(81)	(68)	9	0	9	(77)
2031	12.6	(81)	(69)	9	0	9	(78)
2032	12.6	(82)	(69)	9	0	9	(78)
2033	12.7	(82)	(70)	9	0	9	(79)
2034	12.7	(83)	(70)	9	0	9	(79)
2035	12.8	(84)	(71)	9	0	9	(80)
2036	12.9	(84)	(71)	9	0	9	(80)
2037	12.9	(85)	(72)	9	0	9	(81)
2038	13.0	(85)	(72)	9	0	9	(81)
2039	13.1	(86)	(73)	9	0	9	(82)
2040	13.1	(87)	(73)	9	0	9	(82)
2041	13.2	(87)	(74)	9	0	9	(83)
2042	13.3	(88)	(75)	9	0	9	(84)
2043	13.4	(88)	(75)	9	0	9	(84)
2044	13.4	(89)	(76)	9	0	9	(85)
2045	13.5	(90)	(76)	9	0	9	(85)
2046	13.6	(90)	(77)	9	0	9	(86)
2047	13.7	(91)	(77)	9	0	9	(86)
2048	13.7	(91)	(78)	9	0	9	(87)
2049	13.8	(92)	(78)	9	0	9	(87)
2050	13.9	(93)	(79)	9	0	9	(88)
2051	14.0	(93)	(79)	9	0	9	(88)
2052	14.0	(94)	(80)	9	0	9	(89)
2053	14.1	(94)	(80)	9	0	9	(89)
2054	14.2	(95)	(81)	9	0	9	(90)
2055	14.3	(95)	(81)	9	0	9	(90)
2056	14.4	(96)	(82)	9	0	9	(91)
2057	14.4	(96)	(82)	9	0	9	(91)
2058	14.5	(97)	(82)	9	0	9	(91)
2059	14.6	(97)	(83)	9	0	9	(92)
2060	14.7	(98)	(83)	9	0	9	(92)
2061	14.7	(99)	(84)	9	0	9	(93)
2062	14.8	(99)	(84)	9	0	9	(93)
2063	14.9	(99)	(85)	9	0	9	(94)
2064	15.0	(100)	(85)	9	0	9	(94)
2065	15.0	(100)	(85)	9	0	9	(94)
2066	15.1	(101)	(86)	9	0	9	(95)
2067	15.2	(101)	(86)	9	0	9	(95)
2068	15.2	(102)	(87)	9	0	9	(96)
2069	15.3	(102)	(87)	9	0	9	(96)
2070	15.4	(103)	(87)	9	0	9	(96)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Lampasas quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	178	0	0	0
1	2015	7,687	176	5	(65)	(70)
2	2016	7,630	174	10	(64)	(74)
3	2017	7,573	173	15	(63)	(78)
4	2018	7,516	171	20	(63)	(82)
5-year Goal	2019	7,459	169	25	(62)	(86)
6	2020	7,402	167	29	(61)	(90)
7	2021	7,480	165	34	(62)	(96)
8	2022	7,558	164	40	(63)	(102)
9	2023	7,636	162	45	(63)	(108)
10-year Goal	2024	7,714	160	51	(64)	(115)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Lampasas' most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	7.00	0	0	0
1	2015	7,687	6.98	0	(76)	(76)
2	2016	7,630	6.96	0	(75)	(75)
3	2017	7,573	6.94	0	(75)	(75)
4	2018	7,516	6.92	0	(74)	(74)
5-year Goal	2019	7,459	6.90	0	(74)	(74)
6	2020	7,402	6.82	0	(73)	(73)
7	2021	7,480	6.74	1	(74)	(74)
8	2022	7,558	6.66	1	(74)	(75)
9	2023	7,636	6.58	1	(75)	(76)
10-year Goal	2024	7,714	6.50	1	(76)	(77)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 76 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 15% increase in 2014
    b. Estimated customer demand reduction of 3.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	11.2	11.2
2016	11.3	11.3
2017	11.4	11.4
2018	11.5	11.5
2019	11.6	11.6
2020	11.7	11.7
2021	11.7	11.7
2022	11.8	11.8
2023	11.9	11.9
2024	12.0	12.0
2025	12.1	12.1
2026	12.2	12.2
2027	12.2	12.2
2028	12.3	12.3
2029	12.4	12.4
2030	12.5	12.5
2031	12.6	12.6
2032	12.6	12.6
2033	12.7	12.7
2034	12.7	12.7
2035	12.8	12.8
2036	12.9	12.9
2037	12.9	12.9
2038	13.0	13.0
2039	13.1	13.1
2040	13.1	13.1
2041	13.2	13.2
2042	13.3	13.3
2043	13.4	13.4
2044	13.4	13.4
2045	13.5	13.5
2046	13.6	13.6
2047	13.7	13.7
2048	13.7	13.7
2049	13.8	13.8
2050	13.9	13.9
2051	14.0	14.0
2052	14.0	14.0
2053	14.1	14.1
2054	14.2	14.2
2055	14.3	14.3
2056	14.4	14.4
2057	14.4	14.4
2058	14.5	14.5
2059	14.6	14.6
2060	14.7	14.7
2061	14.7	14.7
2062	14.8	14.8
2063	14.9	14.9
2064	15.0	15.0
2065	15.0	15.0
2066	15.1	15.1
2067	15.2	15.2
2068	15.2	15.2
2069	15.3	15.3
2070	15.4	15.4

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	7.00	0
2015	7,687	34.00	(76)
2016	7,630	34.00	(75)
2017	7,573	34.00	(75)
2018	7,516	34.00	(74)
2019	7,459	34.00	(74)
2020	7,402	34.00	(73)
2021	7,480	34.00	(74)
2022	7,558	34.00	(74)
2023	7,636	34.00	(75)
2024	7,714	34.00	(76)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 29 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	11	(75)	(64)	29	5	0	5	(40)
2017	11	(75)	(63)	29	5	0	5	(39)
2018	11	(74)	(63)	29	6	0	6	(39)
2019	12	(74)	(62)	29	7	0	7	(40)
2020	12	(73)	(61)	29	9	0	9	(41)
2021	12	(74)	(62)	30	9	0	9	(41)
2022	12	(74)	(63)	30	9	0	9	(42)
2023	12	(75)	(63)	30	9	0	9	(42)
2024	12	(76)	(64)	30	9	0	9	(43)
2025	12	(77)	(65)	31	9	0	9	(43)
2026	12	(78)	(65)	31	9	0	9	(44)
2027	12	(78)	(66)	31	9	0	9	(44)
2028	12	(79)	(67)	31	9	0	9	(45)
2029	12	(80)	(67)	31	9	0	9	(45)
2030	12	(81)	(68)	32	9	0	9	(46)
2031	13	(81)	(69)	32	9	0	9	(46)
2032	13	(82)	(69)	32	9	0	9	(46)
2033	13	(82)	(70)	32	9	0	9	(47)
2034	13	(83)	(70)	32	9	0	9	(47)
2035	13	(84)	(71)	32	9	0	9	(47)
2036	13	(84)	(71)	33	9	0	9	(48)
2037	13	(85)	(72)	33	9	0	9	(48)
2038	13	(85)	(72)	33	9	0	9	(49)
2039	13	(86)	(73)	33	9	0	9	(49)
2040	13	(87)	(73)	33	9	0	9	(49)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	11	(75)	(64)	5.1	5	0	5	(64)
2017	11	(75)	(63)	5.1	5	0	5	(63)
2018	11	(74)	(63)	5.1	6	0	6	(63)
2019	12	(74)	(62)	5.2	7	0	7	(64)
2020	12	(73)	(61)	5.2	9	0	9	(65)
2021	12	(74)	(62)	5.2	9	0	9	(66)
2022	12	(74)	(63)	5.3	9	0	9	(66)
2023	12	(75)	(63)	5.3	9	0	9	(67)
2024	12	(76)	(64)	5.4	9	0	9	(68)
2025	12	(77)	(65)	5.4	9	0	9	(68)
2026	12	(78)	(65)	5.4	9	0	9	(69)
2027	12	(78)	(66)	5.5	9	0	9	(70)
2028	12	(79)	(67)	5.5	9	0	9	(70)
2029	12	(80)	(67)	5.5	9	0	9	(71)
2030	12	(81)	(68)	5.6	9	0	9	(72)
2031	13	(81)	(69)	5.6	9	0	9	(72)
2032	13	(82)	(69)	5.6	9	0	9	(73)
2033	13	(82)	(70)	5.7	9	0	9	(73)
2034	13	(83)	(70)	5.7	9	0	9	(74)
2035	13	(84)	(71)	5.7	9	0	9	(74)
2036	13	(84)	(71)	5.8	9	0	9	(75)
2037	13	(85)	(72)	5.8	9	0	9	(75)
2038	13	(85)	(72)	5.8	9	0	9	(76)
2039	13	(86)	(73)	5.8	9	0	9	(76)
2040	13	(87)	(73)	5.9	9	0	9	(77)

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Leander Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Leander's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Leander's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Leander's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Leander with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.6	0	1	0	0	0	1
2016	66.3	0	66	0	0	0	66
2017	74.5	0	74	0	0	0	74
2018	82.6	0	83	0	0	0	83
2019	90.8	0	91	0	0	0	91
2020	99.0	0	99	0	0	0	99
2021	107.1	0	107	0	0	0	107
2022	115.3	0	115	0	0	0	115
2023	123.5	0	123	0	0	0	123
2024	131.7	0	132	0	0	0	132
2025	139.8	0	140	0	0	0	140
2026	148.0	0	148	0	0	0	148
2027	156.2	0	156	0	0	0	156
2028	164.3	0	164	0	0	0	164
2029	172.5	0	173	0	0	0	173
2030	180.7	0	181	0	0	0	181
2031	192.8	0	193	0	0	0	193
2032	204.9	0	205	0	0	0	205
2033	217.0	0	217	0	0	0	217
2034	229.2	0	229	0	0	0	229
2035	241.3	0	241	0	0	0	241
2036	253.4	0	253	0	0	0	253
2037	265.5	0	266	0	0	0	266
2038	277.6	0	278	0	0	0	278
2039	289.7	0	290	0	0	0	290
2040	301.9	0	302	0	0	0	302
2041	316.3	0	316	0	0	0	316
2042	330.7	0	331	0	0	0	331
2043	345.1	0	345	0	0	0	345
2044	359.5	0	360	0	0	0	360
2045	373.9	0	374	0	0	0	374
2046	388.4	0	388	0	0	0	388
2047	402.8	0	403	0	0	0	403
2048	417.2	0	417	0	0	0	417
2049	431.6	0	432	0	0	0	432
2050	446.0	0	446	0	0	0	446
2051	455.8	0	456	0	0	0	456
2052	465.6	0	466	0	0	0	466
2053	475.4	0	475	0	0	0	475
2054	485.2	0	485	0	0	0	485
2055	495.0	0	495	0	0	0	495
2056	504.8	0	505	0	0	0	505
2057	514.6	0	515	0	0	0	515
2058	524.4	0	524	0	0	0	524
2059	534.2	0	534	0	0	0	534
2060	544.0	0	544	0	0	0	544
2061	554.8	0	555	0	0	0	555
2062	565.6	0	566	0	0	0	566
2063	576.4	0	576	0	0	0	576
2064	587.2	0	587	0	0	0	587
2065	598.0	0	598	0	0	0	598
2066	608.8	0	609	0	0	0	609
2067	619.6	0	620	0	0	0	620
2068	630.4	0	630	0	0	0	630
2069	641.2	0	641	0	0	0	641
2070	652.0	0	652	0	0	0	652

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Leander's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	137	0	0	0
1	2015	38,321	137	0	1	1
2	2016	40,769	137	0	66	66
3	2017	43,217	137	0	74	74
4	2018	45,666	137	0	83	83
5-year Goal	2019	48,114	137	0	91	91
6	2020	50,562	136	15	99	84
7	2021	54,944	135	32	107	75
8	2022	59,325	135	52	115	63
9	2023	63,707	134	74	123	49
10-year Goal	2024	68,088	133	99	132	32

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Leander's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	22.00	0	0	0
1	2015	38,321	22.00	0	0	0
2	2016	40,769	22.00	0	0	0
3	2017	43,217	22.00	0	0	0
4	2018	45,666	22.00	0	0	0
5-year Goal	2019	48,114	22.00	0	0	0
6	2020	50,562	21.80	4	0	(4)
7	2021	54,944	21.60	8	0	(8)
8	2022	59,325	21.40	13	0	(13)
9	2023	63,707	21.20	19	0	(19)
10-year Goal	2024	68,088	21.00	25	0	(25)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 0 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **HE Toilet Replacement Program (ICI)**
   a. 31 toilets replaced
   b. Estimated 15,750 gallons per year per toilet (A&N Technical Services, 2005)
   c. 20-year useful life for fixture[17]

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

[17] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

6. **Low-flush Urinal Replacement Program (ICI)**
    a. 13 urinals replaced with 1/2 gallon-per-flush model
    b. Estimated 6,200 gallons per year per toilet (A&N Technical Services, 2005)
    c. 20-year useful life for fixture[18]

[18] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterSmart Software	Low-Flush Urinal (ICI)	HE Toilets (ICI)	TOTAL SAVINGS
2012				0
2013		0.08	0.49	0.6
2014		0.08	0.49	0.6
2015		0.08	0.49	0.6
2016	66	0.08	0.49	66.3
2017	74	0.08	0.49	74.5
2018	82	0.08	0.49	82.6
2019	90	0.08	0.49	90.8
2020	98	0.08	0.49	99.0
2021	107	0.08	0.49	107.1
2022	115	0.08	0.49	115.3
2023	123	0.08	0.49	123.5
2024	131	0.08	0.49	131.7
2025	139	0.08	0.49	139.8
2026	147	0.08	0.49	148.0
2027	156	0.08	0.49	156.2
2028	164	0.08	0.49	164.3
2029	172	0.08	0.49	172.5
2030	180	0.08	0.49	180.7
2031	192	0.08	0.49	192.8
2032	204	0.08	0.49	204.9
2033	216	0.08	0.49	217.0
2034	229	0.08	0.49	229.2
2035	241	0.08	0.49	241.3
2036	253	0.08	0.49	253.4
2037	265	0.08	0.49	265.5
2038	277	0.08	0.49	277.6
2039	289	0.08	0.49	289.7
2040	301	0.08	0.49	301.9
2041	316	0.08	0.49	316.3
2042	330	0.08	0.49	330.7
2043	345	0.08	0.49	345.1
2044	359	0.08	0.49	359.5
2045	373	0.08	0.49	373.9
2046	388	0.08	0.49	388.4
2047	402	0.08	0.49	402.8
2048	417	0.08	0.49	417.2
2049	431	0.08	0.49	431.6
2050	445	0.08	0.49	446.0
2051	455	0.08	0.49	455.8
2052	465	0.08	0.49	465.6
2053	475	0.08	0.49	475.4
2054	485	0.08	0.49	485.2
2055	494	0.08	0.49	495.0
2056	504	0.08	0.49	504.8
2057	514	0.08	0.49	514.6
2058	524	0.08	0.49	524.4
2059	534	0.08	0.49	534.2
2060	543	0.08	0.49	544.0
2061	554	0.08	0.49	554.8
2062	565	0.08	0.49	565.6
2063	576	0.08	0.49	576.4
2064	587	0.08	0.49	587.2
2065	597	0.08	0.49	598.0
2066	608	0.08	0.49	608.8
2067	619	0.08	0.49	619.6
2068	630	0.08	0.49	630.4
2069	641	0.08	0.49	641.2
2070	651	0.08	0.49	652.0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	37,889	20.00	0
2016	38,525	20.00	0
2017	39,162	20.00	0
2018	39,798	20.00	0
2019	40,435	20.00	0
2020	41,071	20.00	0
2021	43,919	20.00	0
2022	46,767	20.00	0
2023	49,615	20.00	0
2024	52,463	20.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        - i. Average Region G savings
        - ii. Specific percentage of outdoor usage unknown for your utility at this time
    - **b.** Savings could be 100 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	66	0	66	100	0	0	0	166
2017	74	0	74	112	0	0	0	186
2018	83	0	83	124	0	0	0	207
2019	91	0	91	137	0	0	0	228
2020	99	0	99	149	0	0	0	248
2021	107	0	107	162	0	0	0	269
2022	115	0	115	174	0	0	0	289
2023	123	0	123	186	0	0	0	310
2024	132	0	132	199	0	0	0	330
2025	140	0	140	211	0	0	0	351
2026	148	0	148	223	0	0	0	371
2027	156	0	156	236	0	0	0	392
2028	164	0	164	248	0	0	0	413
2029	173	0	173	261	0	0	0	433
2030	181	0	181	273	0	0	0	454
2031	193	0	193	291	0	0	0	484
2032	205	0	205	310	0	0	0	515
2033	217	0	217	328	0	0	0	545
2034	229	0	229	347	0	0	0	576
2035	241	0	241	365	0	0	0	606
2036	253	0	253	383	0	0	0	637
2037	266	0	266	402	0	0	0	667
2038	278	0	278	420	0	0	0	698
2039	290	0	290	438	0	0	0	728
2040	302	0	302	457	0	0	0	759

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	66	0	66	18	0	0	0	84
2017	74	0	74	20	0	0	0	94
2018	83	0	83	22	0	0	0	105
2019	91	0	91	24	0	0	0	115
2020	99	0	99	26	0	0	0	125
2021	107	0	107	29	0	0	0	136
2022	115	0	115	31	0	0	0	146
2023	123	0	123	33	0	0	0	156
2024	132	0	132	35	0	0	0	167
2025	140	0	140	37	0	0	0	177
2026	148	0	148	40	0	0	0	188
2027	156	0	156	42	0	0	0	198
2028	164	0	164	44	0	0	0	208
2029	173	0	173	46	0	0	0	219
2030	181	0	181	48	0	0	0	229
2031	193	0	193	52	0	0	0	244
2032	205	0	205	55	0	0	0	260
2033	217	0	217	58	0	0	0	275
2034	229	0	229	61	0	0	0	290
2035	241	0	241	65	0	0	0	306
2036	253	0	253	68	0	0	0	321
2037	266	0	266	71	0	0	0	337
2038	278	0	278	74	0	0	0	352
2039	290	0	290	77	0	0	0	367
2040	302	0	302	81	0	0	0	383

3. Water Rate Increase
  - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
  - **b.** Approximately 26 MG of savings per year with current demand
  - **c.** Savings is cumulative and based on more than one source[20] (U.S. EPA, 1998; Whitcomb, 1999)
  - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

---

[20] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	66	0	66	26	0	0	0	93
2017	74	0	74	30	0	0	0	104
2018	83	0	83	33	0	0	0	115
2019	91	0	91	36	0	0	0	127
2020	99	0	99	39	0	0	0	138
2021	107	0	107	43	0	0	0	150
2022	115	0	115	46	0	0	0	161
2023	123	0	123	49	0	0	0	173
2024	132	0	132	52	0	0	0	184
2025	140	0	140	56	0	0	0	196
2026	148	0	148	59	0	0	0	207
2027	156	0	156	62	0	0	0	218
2028	164	0	164	66	0	0	0	230
2029	173	0	173	69	0	0	0	241
2030	181	0	181	72	0	0	0	253
2031	193	0	193	77	0	0	0	270
2032	205	0	205	82	0	0	0	287
2033	217	0	217	87	0	0	0	304
2034	229	0	229	91	0	0	0	321
2035	241	0	241	96	0	0	0	338
2036	253	0	253	101	0	0	0	355
2037	266	0	266	106	0	0	0	371
2038	278	0	278	111	0	0	0	388
2039	290	0	290	116	0	0	0	405
2040	302	0	302	121	0	0	0	422

4. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Possum Kingdom WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Possum Kingdom WSC's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Possum Kingdom WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Possum Kingdom WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Possum Kingdom WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	9.3	17	26	8	0	8	19
2016	9.4	19	29	10	0	10	19
2017	9.4	22	31	10	0	10	22
2018	9.5	24	34	12	0	12	22
2019	9.6	27	36	13	0	13	23
2020	9.6	29	39	17	0	17	22
2021	9.7	30	39	20	0	20	20
2022	9.7	30	40	22	0	22	18
2023	9.8	30	40	24	0	24	15
2024	9.9	30	40	27	0	27	13
2025	9.9	30	40	29	0	29	11
2026	10.0	31	41	32	0	32	9
2027	10.0	31	41	34	0	34	7
2028	10.1	31	41	36	0	36	5
2029	10.2	31	41	39	0	39	3
2030	10.2	31	42	41	0	41	1
2031	10.3	32	42	43	0	43	(2)
2032	10.3	32	42	46	0	46	(4)
2033	10.3	32	42	48	0	48	(6)
2034	10.4	32	43	50	0	50	(8)
2035	10.4	32	43	53	0	53	(10)
2036	10.5	33	43	55	0	55	(12)
2037	10.5	33	43	57	0	57	(14)
2038	10.5	33	44	60	0	60	(16)
2039	10.6	33	44	62	0	62	(18)
2040	10.6	34	44	65	0	65	(20)
2041	10.7	34	44	67	0	67	(22)
2042	10.7	34	45	69	0	69	(25)
2043	10.7	34	45	72	0	72	(27)
2044	10.8	35	45	74	0	74	(29)
2045	10.8	35	46	76	0	76	(31)
2046	10.9	35	46	79	0	79	(33)
2047	10.9	35	46	81	0	81	(35)
2048	10.9	36	47	84	0	84	(37)
2049	11.0	36	47	86	0	86	(39)
2050	11.0	36	47	88	0	88	(41)
2051	11.0	36	47	91	0	91	(43)
2052	11.1	37	48	93	0	93	(45)
2053	11.1	37	48	95	0	95	(47)
2054	11.1	37	48	98	0	98	(49)
2055	11.2	38	49	100	0	100	(51)
2056	11.2	38	49	102	0	102	(53)
2057	11.2	38	49	105	0	105	(55)
2058	11.3	38	50	107	0	107	(57)
2059	11.3	39	50	109	0	109	(59)
2060	11.3	39	50	111	0	111	(61)
2061	11.4	39	51	114	0	114	(63)
2062	11.4	40	51	116	0	116	(65)
2063	11.4	40	51	118	0	118	(67)
2064	11.4	40	52	120	0	120	(69)
2065	11.5	40	52	123	0	123	(71)
2066	11.5	41	52	125	0	125	(73)
2067	11.5	41	52	127	0	127	(75)
2068	11.5	41	53	129	0	129	(76)
2069	11.6	42	53	131	0	131	(78)
2070	11.6	42	53	134	0	134	(80)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Possum Kingdom WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	300	0	0	0
1	2015	2,433	300	0	26	26
2	2016	2,795	300	0	29	29
3	2017	3,156	300	0	31	31
4	2018	3,518	300	0	34	34
5-year Goal	2019	3,879	300	0	36	36
6	2020	4,241	300	0	39	39
7	2021	4,270	300	0	39	39
8	2022	4,299	300	0	40	40
9	2023	4,328	300	0	40	40
10-year Goal	2024	4,357	300	0	40	40

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Possum Kingdom WSC's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	45.00	0	0	0
1	2015	2,433	45.00	0	17	17
2	2016	2,795	45.00	0	19	19
3	2017	3,156	45.00	0	22	22
4	2018	3,518	45.00	0	24	24
5-year Goal	2019	3,879	45.00	0	27	27
6	2020	4,241	43.80	2	29	28
7	2021	4,270	42.60	4	30	26
8	2022	4,299	41.40	6	30	24
9	2023	4,328	40.20	8	30	22
10-year Goal	2024	4,357	39.00	10	30	21

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 17 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 13.5% increase in 2014
        ii. 5.0% increase in 2015
    b. Estimated customer demand reduction of 3.64%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	6.8	6.8
2015	9.3	9.3
2016	9.4	9.4
2017	9.4	9.4
2018	9.5	9.5
2019	9.6	9.6
2020	9.6	9.6
2021	9.7	9.7
2022	9.7	9.7
2023	9.8	9.8
2024	9.9	9.9
2025	9.9	9.9
2026	10.0	10.0
2027	10.0	10.0
2028	10.1	10.1
2029	10.2	10.2
2030	10.2	10.2
2031	10.3	10.3
2032	10.3	10.3
2033	10.3	10.3
2034	10.4	10.4
2035	10.4	10.4
2036	10.5	10.5
2037	10.5	10.5
2038	10.5	10.5
2039	10.6	10.6
2040	10.6	10.6
2041	10.7	10.7
2042	10.7	10.7
2043	10.7	10.7
2044	10.8	10.8
2045	10.8	10.8
2046	10.9	10.9
2047	10.9	10.9
2048	10.9	10.9
2049	11.0	11.0
2050	11.0	11.0
2051	11.0	11.0
2052	11.1	11.1
2053	11.1	11.1
2054	11.1	11.1
2055	11.2	11.2
2056	11.2	11.2
2057	11.2	11.2
2058	11.3	11.3
2059	11.3	11.3
2060	11.3	11.3
2061	11.4	11.4
2062	11.4	11.4
2063	11.4	11.4
2064	11.4	11.4
2065	11.5	11.5
2066	11.5	11.5
2067	11.5	11.5
2068	11.5	11.5
2069	11.6	11.6
2070	11.6	11.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	45.00	0
2015	2,433	26.00	17
2016	2,795	26.00	19
2017	3,156	26.00	22
2018	3,518	26.00	24
2019	3,879	26.00	27
2020	4,241	26.00	29
2021	4,270	26.00	30
2022	4,299	26.00	30
2023	4,328	26.00	30
2024	4,357	26.00	30

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region G savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 20 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG)

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	9	19	29	20	10	0	10	39
2017	9	22	31	20	10	0	10	41
2018	10	24	34	20	12	0	12	42
2019	10	27	36	20	13	0	13	43
2020	10	29	39	20	17	0	17	42
2021	10	30	39	20	20	0	20	40
2022	10	30	40	20	22	0	22	38
2023	10	30	40	20	24	0	24	36
2024	10	30	40	21	27	0	27	34
2025	10	30	40	21	29	0	29	32
2026	10	31	41	21	32	0	32	30
2027	10	31	41	21	34	0	34	28
2028	10	31	41	21	36	0	36	26
2029	10	31	41	21	39	0	39	24
2030	10	31	42	21	41	0	41	22
2031	10	32	42	21	43	0	43	20
2032	10	32	42	21	46	0	46	18
2033	10	32	42	21	48	0	48	16
2034	10	32	43	22	50	0	50	14
2035	10	32	43	22	53	0	53	12
2036	10	33	43	22	55	0	55	10
2037	11	33	43	22	57	0	57	8
2038	11	33	44	22	60	0	60	6
2039	11	33	44	22	62	0	62	4
2040	11	34	44	22	65	0	65	2

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	9	19	29	3	10	0	10	23
2017	9	22	31	3	10	0	10	25
2018	10	24	34	3	12	0	12	26
2019	10	27	36	4	13	0	13	27
2020	10	29	39	4	17	0	17	25
2021	10	30	39	4	20	0	20	23
2022	10	30	40	4	22	0	22	21
2023	10	30	40	4	24	0	24	19
2024	10	30	40	4	27	0	27	17
2025	10	30	40	4	29	0	29	15
2026	10	31	41	4	32	0	32	13
2027	10	31	41	4	34	0	34	11
2028	10	31	41	4	36	0	36	9
2029	10	31	41	4	39	0	39	6
2030	10	31	42	4	41	0	41	4
2031	10	32	42	4	43	0	43	2
2032	10	32	42	4	46	0	46	0
2033	10	32	42	4	48	0	48	(2)
2034	10	32	43	4	50	0	50	(4)
2035	10	32	43	4	53	0	53	(6)
2036	10	33	43	4	55	0	55	(8)
2037	11	33	43	4	57	0	57	(10)
2038	11	33	44	4	60	0	60	(12)
2039	11	33	44	4	62	0	62	(14)
2040	11	34	44	4	65	0	65	(16)

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Robinson Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Robinson's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Robinson's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Robinson's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Robinson with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	14.5	(4)	10	13	0	13	(3)
2016	29.6	(4)	25	16	0	16	9
2017	30.1	(4)	26	16	0	16	9
2018	30.7	(4)	26	20	0	20	6
2019	31.2	(5)	27	23	0	23	4
2020	31.8	(5)	27	30	0	30	(3)
2021	32.3	(5)	28	37	0	37	(9)
2022	32.9	(5)	28	44	0	44	(16)
2023	33.4	(5)	29	52	0	52	(23)
2024	33.9	(5)	29	59	0	59	(30)
2025	34.5	(5)	29	66	0	66	(37)
2026	35.0	(5)	30	74	0	74	(44)
2027	35.6	(5)	30	81	0	81	(51)
2028	36.1	(5)	31	88	0	88	(58)
2029	36.7	(5)	31	96	0	96	(64)
2030	37.2	(6)	32	103	0	103	(71)
2031	37.7	(6)	32	109	0	109	(77)
2032	38.2	(6)	32	115	0	115	(83)
2033	38.7	(6)	33	122	0	122	(89)
2034	39.2	(6)	33	128	0	128	(95)
2035	39.7	(6)	34	134	0	134	(100)
2036	40.1	(6)	34	140	0	140	(106)
2037	40.6	(6)	35	147	0	147	(112)
2038	41.1	(6)	35	153	0	153	(118)
2039	41.6	(6)	35	159	0	159	(124)
2040	42.1	(6)	36	165	0	165	(129)
2041	42.6	(6)	36	167	0	167	(130)
2042	43.1	(6)	37	168	0	168	(131)
2043	43.6	(7)	37	169	0	169	(132)
2044	44.1	(7)	37	171	0	171	(133)
2045	44.6	(7)	38	172	0	172	(134)
2046	45.1	(7)	38	173	0	173	(135)
2047	45.6	(7)	39	175	0	175	(136)
2048	46.2	(7)	39	176	0	176	(137)
2049	46.7	(7)	40	178	0	178	(138)
2050	47.2	(7)	40	179	0	179	(139)
2051	47.7	(7)	40	181	0	181	(140)
2052	48.2	(7)	41	183	0	183	(142)
2053	48.7	(7)	41	184	0	184	(143)
2054	49.3	(7)	42	186	0	186	(144)
2055	49.8	(8)	42	188	0	188	(146)
2056	50.3	(8)	43	190	0	190	(147)
2057	50.8	(8)	43	192	0	192	(149)
2058	51.4	(8)	44	194	0	194	(150)
2059	51.9	(8)	44	195	0	195	(151)
2060	52.4	(8)	44	197	0	197	(153)
2061	52.9	(8)	45	199	0	199	(154)
2062	53.4	(8)	45	201	0	201	(156)
2063	54.0	(8)	46	203	0	203	(157)
2064	54.5	(8)	46	205	0	205	(159)
2065	55.0	(8)	47	207	0	207	(160)
2066	55.5	(8)	47	209	0	209	(161)
2067	56.0	(9)	48	210	0	210	(163)
2068	56.6	(9)	48	212	0	212	(164)
2069	57.1	(9)	48	214	0	214	(166)
2070	57.6	(9)	49	216	0	216	(167)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Robinson's quantified savings from its implemented activities compare with 5- and 10- year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	140	0	0	0
1	2015	11,484	138	10	10	0
2	2016	11,720	135	21	25	5
3	2017	11,956	133	31	26	(6)
4	2018	12,193	130	43	26	(16)
5-year Goal	2019	12,429	128	54	27	(28)
6	2020	12,665	127	58	27	(31)
7	2021	12,914	127	62	28	(35)
8	2022	13,163	126	66	28	(38)
9	2023	13,413	126	70	29	(42)
10-year Goal	2024	13,662	125	75	29	(46)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Robinson's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	8.00	0	0	0
1	2015	11,484	7.80	1	(4)	(5)
2	2016	11,720	7.60	2	(4)	(6)
3	2017	11,956	7.40	3	(4)	(7)
4	2018	12,193	7.20	4	(4)	(8)
5-year Goal	2019	12,429	7.00	5	(5)	(9)
6	2020	12,665	7.00	5	(5)	(9)
7	2021	12,914	7.00	5	(5)	(9)
8	2022	13,163	7.00	5	(5)	(10)
9	2023	13,413	7.00	5	(5)	(10)
10-year Goal	2024	13,662	7.00	5	(5)	(10)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 4 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10.0% increase in 2015
        ii. 10.0% increase in 2016
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0.0
2010		0.0
2011		0.0
2012		0.0
2013		0.0
2014		0.0
2015	14.5	14.5
2016	29.6	29.6
2017	30.1	30.1
2018	30.7	30.7
2019	31.2	31.2
2020	31.8	31.8
2021	32.3	32.3
2022	32.9	32.9
2023	33.4	33.4
2024	33.9	33.9
2025	34.5	34.5
2026	35.0	35.0
2027	35.6	35.6
2028	36.1	36.1
2029	36.7	36.7
2030	37.2	37.2
2031	37.7	37.7
2032	38.2	38.2
2033	38.7	38.7
2034	39.2	39.2
2035	39.7	39.7
2036	40.1	40.1
2037	40.6	40.6
2038	41.1	41.1
2039	41.6	41.6
2040	42.1	42.1
2041	42.6	42.6
2042	43.1	43.1
2043	43.6	43.6
2044	44.1	44.1
2045	44.6	44.6
2046	45.1	45.1
2047	45.6	45.6
2048	46.2	46.2
2049	46.7	46.7
2050	47.2	47.2
2051	47.7	47.7
2052	48.2	48.2
2053	48.7	48.7
2054	49.3	49.3
2055	49.8	49.8
2056	50.3	50.3
2057	50.8	50.8
2058	51.4	51.4
2059	51.9	51.9
2060	52.4	52.4
2061	52.9	52.9
2062	53.4	53.4
2063	54.0	54.0
2064	54.5	54.5
2065	55.0	55.0
2066	55.5	55.5
2067	56.0	56.0
2068	56.6	56.6
2069	57.1	57.1
2070	57.6	57.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	8.00	0
2015	11,484	9.00	(4)
2016	11,720	9.00	(4)
2017	11,956	9.00	(4)
2018	12,193	9.00	(4)
2019	12,429	9.00	(5)
2020	12,665	9.00	(5)
2021	12,914	9.00	(5)
2022	13,163	9.00	(5)
2023	13,413	9.00	(5)
2024	13,662	9.00	(5)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8.42% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 62 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	30	(4)	25	62	16	0	16	71
2017	30	(4)	26	63	16	0	16	73
2018	31	(4)	26	65	20	0	20	71
2019	31	(5)	27	66	23	0	23	69
2020	32	(5)	27	67	30	0	30	64
2021	32	(5)	28	68	37	0	37	59
2022	33	(5)	28	69	44	0	44	53
2023	33	(5)	29	70	52	0	52	47
2024	34	(5)	29	71	59	0	59	41
2025	34	(5)	29	73	66	0	66	36
2026	35	(5)	30	74	74	0	74	30
2027	36	(5)	30	75	81	0	81	24
2028	36	(5)	31	76	88	0	88	19
2029	37	(5)	31	77	96	0	96	13
2030	37	(6)	32	78	103	0	103	7
2031	38	(6)	32	79	109	0	109	2
2032	38	(6)	32	80	115	0	115	(3)
2033	39	(6)	33	81	122	0	122	(7)
2034	39	(6)	33	82	128	0	128	(12)
2035	40	(6)	34	83	134	0	134	(17)
2036	40	(6)	34	85	140	0	140	(22)
2037	41	(6)	35	86	147	0	147	(26)
2038	41	(6)	35	87	153	0	153	(31)
2039	42	(6)	35	88	159	0	159	(36)
2040	42	(6)	36	89	165	0	165	(41)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	30	(4)	25	10	16	0	16	19
2017	30	(4)	26	10	16	0	16	19
2018	31	(4)	26	10	20	0	20	17
2019	31	(5)	27	10	23	0	23	14
2020	32	(5)	27	11	30	0	30	8
2021	32	(5)	28	11	37	0	37	1
2022	33	(5)	28	11	44	0	44	(5)
2023	33	(5)	29	11	52	0	52	(12)
2024	34	(5)	29	11	59	0	59	(19)
2025	34	(5)	29	12	66	0	66	(25)
2026	35	(5)	30	12	74	0	74	(32)
2027	36	(5)	30	12	81	0	81	(39)
2028	36	(5)	31	12	88	0	88	(45)
2029	37	(5)	31	12	96	0	96	(52)
2030	37	(6)	32	12	103	0	103	(59)
2031	38	(6)	32	13	109	0	109	(64)
2032	38	(6)	32	13	115	0	115	(70)
2033	39	(6)	33	13	122	0	122	(76)
2034	39	(6)	33	13	128	0	128	(81)
2035	40	(6)	34	13	134	0	134	(87)
2036	40	(6)	34	13	140	0	140	(93)
2037	41	(6)	35	14	147	0	147	(98)
2038	41	(6)	35	14	153	0	153	(104)
2039	42	(6)	35	14	159	0	159	(110)
2040	42	(6)	36	14	165	0	165	(115)

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Round Rock Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Round Rock's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Round Rock's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Round Rock's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Round Rock with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	245	154	399	77	0	77	322
2016	293	160	454	97	0	97	357
2017	297	167	464	97	0	97	368
2018	304	173	477	116	0	116	361
2019	310	179	489	135	0	135	354
2020	316	186	502	174	0	174	328
2021	323	190	513	161	0	161	353
2022	330	195	525	147	0	147	377
2023	336	199	536	134	0	134	401
2024	343	204	546	121	0	121	425
2025	348	208	557	108	0	108	449
2026	355	213	567	95	0	95	473
2027	361	217	579	82	0	82	497
2028	368	222	590	69	0	69	522
2029	375	226	602	56	0	56	546
2030	382	231	613	42	0	42	571
2031	391	235	626	73	0	73	553
2032	400	239	639	104	0	104	535
2033	408	243	651	134	0	134	517
2034	417	247	664	165	0	165	499
2035	426	251	677	196	0	196	482
2036	435	255	690	226	0	226	464
2037	443	259	703	257	0	257	446
2038	452	263	715	287	0	287	428
2039	461	267	728	318	0	318	410
2040	470	271	741	349	0	349	392
2041	479	277	757	406	0	406	350
2042	489	283	772	464	0	464	309
2043	498	289	788	521	0	521	267
2044	508	295	803	579	0	579	225
2045	518	301	819	636	0	636	183
2046	527	307	834	693	0	693	141
2047	537	313	850	751	0	751	99
2048	546	319	865	808	0	808	57
2049	556	325	881	866	0	866	15
2050	565	331	896	923	0	923	(27)
2051	576	338	914	1,004	0	1,004	(90)
2052	587	345	933	1,085	0	1,085	(153)
2053	598	353	951	1,166	0	1,166	(216)
2054	609	360	969	1,247	0	1,247	(278)
2055	620	367	987	1,328	0	1,328	(341)
2056	631	374	1,005	1,409	0	1,409	(404)
2057	642	382	1,024	1,490	0	1,490	(467)
2058	653	389	1,042	1,571	0	1,571	(530)
2059	664	396	1,060	1,652	0	1,652	(592)
2060	675	403	1,078	1,733	0	1,733	(655)
2061	686	410	1,096	1,836	0	1,836	(739)
2062	698	417	1,115	1,938	0	1,938	(823)
2063	709	424	1,133	2,040	0	2,040	(907)
2064	720	431	1,151	2,142	0	2,142	(991)
2065	732	438	1,169	2,245	0	2,245	(1,075)
2066	743	444	1,187	2,347	0	2,347	(1,159)
2067	754	451	1,206	2,449	0	2,449	(1,243)
2068	766	458	1,224	2,551	0	2,551	(1,327)
2069	777	465	1,242	2,654	0	2,654	(1,411)
2070	789	472	1,260	2,756	0	2,756	(1,495)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Round Rock's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	105,405	148	77	399	322
2	2016	109,780	146	160	454	293
3	2017	114,155	144	250	464	214
4	2018	118,529	142	346	477	131
5-year Goal	2019	122,904	140	449	489	40
6	2020	127,279	140	465	502	37
7	2021	130,373	140	476	513	38
8	2022	133,467	140	487	525	38
9	2023	136,560	140	498	536	37
10-year Goal	2024	139,654	140	510	546	37

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Round Rock's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	105,405	15.80	8	154	146
2	2016	109,780	15.60	16	160	144
3	2017	114,155	15.40	25	167	142
4	2018	118,529	15.20	35	173	138
5-year Goal	2019	122,904	15.00	45	179	135
6	2020	127,279	14.60	65	186	121
7	2021	130,373	14.20	86	190	105
8	2022	133,467	13.80	107	195	88
9	2023	136,560	13.40	130	199	70
10-year Goal	2024	139,654	13.00	153	204	51

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 154 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3.0% increase in 2015
        ii. 3.0% increase in 2016
    b. Estimated customer demand reduction of 1.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

7. **Outdoor Landscape Evaluations (SF)**
    a. 643 outdoor evaluations performed from 2009 – 2015
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    c. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    d. Approximately 22 gallons per day
    e. Greater savings during peak periods
    f. Lesser savings during off-peak periods
    g. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. **Rain Barrels**
    a. In Region G, estimated savings of 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002)
    b. Capacity rebated varied by year and was provided by staff
    c. Estimated 10-year useful life for most barrels and systems

9. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. 1,600 toilets replaced from 2010 – 2015
    b. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    c. Rebates per year provided by staff
    d. Savings carry on indefinitely because replacement toilet will be as efficient

10. **HE Toilet Replacement Program (MF)**
    a. 17 toilets replaced from 2014 – 2015
    b. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    c. Rebates per year provided by staff
    d. 20-year useful life for fixture[20]

[20] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

11. **Tank-type HE Toilet Replacement Program (ICI)**
    a. 13 toilets replaced in 2014
    b. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
    c. Rebates per year provided by staff
    d. 20-year useful life for fixture[21]

12. **Clotheswasher Replacement Program (SF)**
    a. 272 rebates issued from 2012 – 2015
    b. Rebates per year provided by staff
    c. Estimated 7,030 gallons per year per washer (A&N, Technical Services 2005; THELMA, 1997)
    d. 11-year useful life

13. **Large Landscape Irrigation System Audits**
    a. 33 audits performed from 2009 – 2015
    b. Number of audits per year provided by staff
    c. Estimated savings of 164,500 gallons per year per audit
    d. Used EPA WaterSense Water Budget Tool Formula[22] with 87,120 sq. ft. as basis for large landscape hydrozone
    e. Savings assumed to last 5 years with no decay rate

14. **Irrigation Controller Rebate (SF)**
    a. Estimated savings of 11,340 gallons per year per controller
    b. Used EPA WaterSense Water Budget Tool Formula[23] with 4,000 sq. ft. as basis for landscape hydrozone
    c. Number of rebates per year provided by staff
        i. Savings assumed to last 10 years with no decay rate

---

[21] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.
[22] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$
[23] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rate Increases	Conservation Pricing	Rain Barrels	Tank-type HE Toilets (ICI)	Valve-type HE Toilets (ICI)	Pre-rinse Spray Valves (ICI)	Outdoor Landscape Evaluations (SF)	HE Toilets (SF)	HE Toilets (MF)	HE Clothes Washer Rebates (SF)	Large Landscape Irrigation Evaluations	Irrigation Controller Rebates (SF)	TOTAL SAVINGS
2009		148					0.4				1		149
2010		152					1.1	4.1			2.1	0.1	160
2011		157					2.0	5.7			2.4	0.1	167
2012		162	0.3				2.5	9.0			4.5	0.1	178
2013		166	1.0				3.4	12.0		0.8	5.6	0.1	189
2014		171	2.2	0.2			2.2	14.7	0.1	1.5	4.5	0.1	197
2015	42	176	2.6	0.2			2.1	16.6	0.2	1.9	3.6	0.3	245
2016	87	180	2.6	0.2			1.3	16.6	0.2	1.9	3.3	0.3	293
2017	89	185	2.6	0.2			0.7	16.6	0.2	1.9	1.2	0.3	297
2018	91	190	2.6	0.2			1.0	16.6	0.2	1.9	0.2	0.3	304
2019	93	194	2.6	0.2			0.1	16.6	0.2	1.9	0.2	0.3	310
2020	95	199	2.6	0.2				16.6	0.2	1.9		0.3	316
2021	98	204	2.6	0.2				16.6	0.2	1.9		0.3	323
2022	100	208	2.6	0.2				16.6	0.2	1.9		0.3	330
2023	102	213	2.3	0.2				16.6	0.2	1.9		0.2	336
2024	104	217	1.6	0.2				16.6	0.2	1.9		0.2	343
2025	107	222	0.4	0.2				16.6	0.2	1.9		0.2	348
2026	109	227		0.2				16.6	0.2	1.9			355
2027	111	231		0.2				16.6	0.2	1.9			361
2028	113	236		0.2				16.6	0.2	1.9			368
2029	116	241		0.2				16.6	0.2	1.9			375
2030	118	245		0.2				16.6	0.2	1.9			382
2031	121	251		0.2				16.6	0.2	1.9			391
2032	123	257		0.2				16.6	0.2	1.9			400
2033	126	263		0.2				16.6	0.2	1.9			408
2034	129	269		0.2				16.6	0.2	1.9			417
2035	132	275		0.2				16.6	0.2	1.9			426
2036	135	281		0.2				16.6	0.2	1.9			435
2037	138	287		0.2				16.6	0.2	1.9			443
2038	141	293		0.2				16.6	0.2	1.9			452
2039	143	299		0.2				16.6	0.2	1.9			461
2040	146	305		0.2				16.6	0.2	1.9			470
2041	149	311		0.2				16.6	0.2	1.9			479
2042	152	318		0.2				16.6	0.2	1.9			489
2043	156	324		0.2				16.6	0.2	1.9			498
2044	159	330		0.2				16.6	0.2	1.9			508
2045	162	337		0.2				16.6	0.2	1.9			518
2046	165	343		0.2				16.6	0.2	1.9			527
2047	168	350		0.2				16.6	0.2	1.9			537
2048	171	356		0.2				16.6	0.2	1.9			546
2049	174	363		0.2				16.6	0.2	1.9			556
2050	177	369		0.2				16.6	0.2	1.9			565
2051	181	377		0.2				16.6	0.2	1.9			576
2052	184	384		0.2				16.6	0.2	1.9			587
2053	188	391		0.2				16.6	0.2	1.9			598
2054	191	399		0.2				16.6	0.2	1.9			609
2055	195	406		0.2				16.6	0.2	1.9			620
2056	199	414		0.2				16.6	0.2	1.9			631
2057	202	421		0.2				16.6	0.2	1.9			642
2058	206	428		0.2				16.6	0.2	1.9			653
2059	209	436		0.2				16.6	0.2	1.9			664
2060	213	443		0.2				16.6	0.2	1.9			675
2061	216	451		0.2				16.6	0.2	1.9			686
2062	220	459		0.2				16.6	0.2	1.9			698
2063	224	466		0.2				16.6	0.2	1.9			709
2064	228	474		0.2				16.6	0.2	1.9			720
2065	231	482		0.2				16.6	0.2	1.9			732
2066	235	489		0.2				16.6	0.2	1.9			743
2067	239	497		0.2				16.6	0.2	1.9			754
2068	242	505		0.2				16.6	0.2	1.9			766
2069	246	512		0.2				16.6	0.2	1.9			777
2070	250	520		0.2				16.6	0.2	1.9			789

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	105,405	12.00	154
2016	109,780	12.00	160
2017	114,155	12.00	167
2018	118,529	12.00	173
2019	122,904	12.00	179
2020	127,279	12.00	186
2021	130,373	12.00	190
2022	133,467	12.00	195
2023	136,560	12.00	199
2024	139,654	12.00	204

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 577 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	293	160	454	577	97	0	97	934
2017	297	167	464	592	97	0	97	960
2018	304	173	477	607	116	0	116	968
2019	310	179	489	622	135	0	135	976
2020	316	186	502	636	174	0	174	965
2021	323	190	513	651	161	0	161	1,004
2022	330	195	525	666	147	0	147	1,044
2023	336	199	536	681	134	0	134	1,082
2024	343	204	546	696	121	0	121	1,121
2025	348	208	557	711	108	0	108	1,159
2026	355	213	567	726	95	0	95	1,198
2027	361	217	579	740	82	0	82	1,238
2028	368	222	590	755	69	0	69	1,277
2029	375	226	602	770	56	0	56	1,316
2030	382	231	613	785	42	0	42	1,356
2031	391	235	626	804	73	0	73	1,357
2032	400	239	639	823	104	0	104	1,358
2033	408	243	651	842	134	0	134	1,359
2034	417	247	664	861	165	0	165	1,360
2035	426	251	677	880	196	0	196	1,361
2036	435	255	690	899	226	0	226	1,363
2037	443	259	703	918	257	0	257	1,364
2038	452	263	715	937	287	0	287	1,365
2039	461	267	728	956	318	0	318	1,366
2040	470	271	741	975	349	0	349	1,367

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[24]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[24] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	293	160	454	97	97	0	97	454
2017	297	167	464	99	97	0	97	467
2018	304	173	477	102	116	0	116	463
2019	310	179	489	104	135	0	135	458
2020	316	186	502	107	174	0	174	435
2021	323	190	513	109	161	0	161	462
2022	330	195	525	112	147	0	147	489
2023	336	199	536	114	134	0	134	516
2024	343	204	546	117	121	0	121	542
2025	348	208	557	119	108	0	108	568
2026	355	213	567	122	95	0	95	594
2027	361	217	579	124	82	0	82	621
2028	368	222	590	127	69	0	69	648
2029	375	226	602	129	56	0	56	675
2030	382	231	613	131	42	0	42	702
2031	391	235	626	135	73	0	73	687
2032	400	239	639	138	104	0	104	673
2033	408	243	651	141	134	0	134	658
2034	417	247	664	144	165	0	165	644
2035	426	251	677	147	196	0	196	629
2036	435	255	690	151	226	0	226	614
2037	443	259	703	154	257	0	257	600
2038	452	263	715	157	287	0	287	585
2039	461	267	728	160	318	0	318	570
2040	470	271	741	163	349	0	349	556

Statewide Water Conservation Quantification Project
City of Sweetwater Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sweetwater's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Sweetwater's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sweetwater's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8][9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sweetwater with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	17.9	(8)	10	6	0	6	4
2016	17.9	(8)	10	7	0	7	3
2017	18.0	(8)	10	7	0	7	3
2018	18.0	(8)	10	8	0	8	1
2019	18.1	(8)	10	10	0	10	(0)
2020	18.1	(8)	10	13	0	13	(3)
2021	18.1	(8)	10	13	0	13	(3)
2022	18.2	(9)	10	13	0	13	(3)
2023	18.2	(9)	10	13	0	13	(3)
2024	18.3	(9)	10	13	0	13	(3)
2025	18.3	(9)	10	13	0	13	(3)
2026	18.3	(9)	10	13	0	13	(3)
2027	18.4	(9)	10	13	0	13	(3)
2028	18.4	(9)	10	13	0	13	(3)
2029	18.5	(9)	10	13	0	13	(3)
2030	18.5	(9)	10	13	0	13	(3)
2031	18.5	(9)	10	13	0	13	(3)
2032	18.5	(9)	10	13	0	13	(3)
2033	18.6	(9)	10	13	0	13	(3)
2034	18.6	(9)	10	13	0	13	(3)
2035	18.6	(9)	10	13	0	13	(3)
2036	18.6	(9)	10	13	0	13	(3)
2037	18.6	(9)	10	13	0	13	(3)
2038	18.7	(9)	9	13	0	13	(4)
2039	18.7	(9)	9	13	0	13	(4)
2040	18.7	(9)	9	13	0	13	(4)
2041	18.8	(9)	9	13	0	13	(4)
2042	18.8	(9)	10	13	0	13	(3)
2043	18.9	(9)	10	13	0	13	(3)
2044	19.0	(9)	10	13	0	13	(3)
2045	19.0	(9)	10	13	0	13	(3)
2046	19.1	(9)	10	13	0	13	(3)
2047	19.1	(9)	10	13	0	13	(3)
2048	19.2	(10)	10	13	0	13	(3)
2049	19.3	(10)	10	13	0	13	(3)
2050	19.3	(10)	10	13	0	13	(3)
2051	19.4	(10)	10	13	0	13	(3)
2052	19.4	(10)	10	13	0	13	(3)
2053	19.5	(10)	10	13	0	13	(3)
2054	19.5	(10)	10	13	0	13	(3)
2055	19.6	(10)	10	13	0	13	(3)
2056	19.6	(10)	10	13	0	13	(3)
2057	19.7	(10)	10	13	0	13	(3)
2058	19.7	(10)	10	13	0	13	(3)
2059	19.8	(10)	10	13	0	13	(3)
2060	19.8	(10)	10	13	0	13	(3)
2061	19.9	(10)	10	13	0	13	(3)
2062	19.9	(10)	10	13	0	13	(3)
2063	20.0	(10)	10	13	0	13	(3)
2064	20.0	(10)	10	13	0	13	(3)
2065	20.1	(10)	10	13	0	13	(3)
2066	20.1	(10)	10	13	0	13	(3)
2067	20.2	(10)	10	13	0	13	(3)
2068	20.2	(10)	10	13	0	13	(3)
2069	20.3	(10)	10	13	0	13	(3)
2070	20.3	(10)	10	13	0	13	(3)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sweetwater's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	164	0		0
1	2015	10,943	164	1	10	9
2	2016	11,067	164	2	10	8
3	2017	11,191	163	2	10	7
4	2018	11,316	163	3	10	6
5-year Goal	2019	11,440	163	4	10	6
6	2020	11,564	162	7	10	3
7	2021	11,629	162	9	10	0
8	2022	11,694	161	12	10	(2)
9	2023	11,759	161	15	10	(5)
10-year Goal	2024	11,824	160	17	10	(8)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sweetwater's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	29.00	0	0	0
1	2015	10,943	28.20	3	(8)	(11)
2	2016	11,067	27.40	6	(8)	(15)
3	2017	11,191	26.60	10	(8)	(18)
4	2018	11,316	25.80	13	(8)	(21)
5-year Goal	2019	11,440	25.00	17	(8)	(25)
6	2020	11,564	25.00	17	(8)	(25)
7	2021	11,629	25.00	17	(8)	(25)
8	2022	11,694	25.00	17	(9)	(26)
9	2023	11,759	25.00	17	(9)	(26)
10-year Goal	2024	11,824	25.00	17	(9)	(26)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 8 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 15.0% increase in 2015
    b. Estimated customer demand reduction of 3.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	17.9	17.9
2016	17.9	17.9
2017	18.0	18.0
2018	18.0	18.0
2019	18.1	18.1
2020	18.1	18.1
2021	18.1	18.1
2022	18.2	18.2
2023	18.2	18.2
2024	18.3	18.3
2025	18.3	18.3
2026	18.3	18.3
2027	18.4	18.4
2028	18.4	18.4
2029	18.5	18.5
2030	18.5	18.5
2031	18.5	18.5
2032	18.5	18.5
2033	18.6	18.6
2034	18.6	18.6
2035	18.6	18.6
2036	18.6	18.6
2037	18.6	18.6
2038	18.7	18.7
2039	18.7	18.7
2040	18.7	18.7
2041	18.8	18.8
2042	18.8	18.8
2043	18.9	18.9
2044	19.0	19.0
2045	19.0	19.0
2046	19.1	19.1
2047	19.1	19.1
2048	19.2	19.2
2049	19.3	19.3
2050	19.3	19.3
2051	19.4	19.4
2052	19.4	19.4
2053	19.5	19.5
2054	19.5	19.5
2055	19.6	19.6
2056	19.6	19.6
2057	19.7	19.7
2058	19.7	19.7
2059	19.8	19.8
2060	19.8	19.8
2061	19.9	19.9
2062	19.9	19.9
2063	20.0	20.0
2064	20.0	20.0
2065	20.1	20.1
2066	20.1	20.1
2067	20.2	20.2
2068	20.2	20.2
2069	20.3	20.3
2070	20.3	20.3

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	29.00	0
2015	10,943	31.00	(8)
2016	11,067	31.00	(8)
2017	11,191	31.00	(8)
2018	11,316	31.00	(8)
2019	11,440	31.00	(8)
2020	11,564	31.00	(8)
2021	11,629	31.00	(8)
2022	11,694	31.00	(9)
2023	11,759	31.00	(9)
2024	11,824	31.00	(9)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 6.74% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 40 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	18	(8)	10	40	7	0	7	43
2017	18	(8)	10	40	7	0	7	43
2018	18	(8)	10	41	8	0	8	42
2019	18	(8)	10	41	10	0	10	40
2020	18	(8)	10	41	13	0	13	38
2021	18	(8)	10	41	13	0	13	38
2022	18	(9)	10	41	13	0	13	38
2023	18	(9)	10	41	13	0	13	38
2024	18	(9)	10	41	13	0	13	38
2025	18	(9)	10	41	13	0	13	38
2026	18	(9)	10	41	13	0	13	38
2027	18	(9)	10	41	13	0	13	38
2028	18	(9)	10	41	13	0	13	38
2029	18	(9)	10	41	13	0	13	38
2030	19	(9)	10	42	13	0	13	38
2031	19	(9)	10	42	13	0	13	38
2032	19	(9)	10	42	13	0	13	38
2033	19	(9)	10	42	13	0	13	38
2034	19	(9)	10	42	13	0	13	38
2035	19	(9)	10	42	13	0	13	38
2036	19	(9)	10	42	13	0	13	38
2037	19	(9)	10	42	13	0	13	38
2038	19	(9)	9	42	13	0	13	38
2039	19	(9)	9	42	13	0	13	38
2040	19	(9)	9	42	13	0	13	38

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	18	(8)	10	8	7	0	7	11
2017	18	(8)	10	8	7	0	7	11
2018	18	(8)	10	8	8	0	8	9
2019	18	(8)	10	8	10	0	10	8
2020	18	(8)	10	8	13	0	13	5
2021	18	(8)	10	8	13	0	13	5
2022	18	(9)	10	8	13	0	13	5
2023	18	(9)	10	8	13	0	13	5
2024	18	(9)	10	8	13	0	13	5
2025	18	(9)	10	8	13	0	13	5
2026	18	(9)	10	8	13	0	13	5
2027	18	(9)	10	8	13	0	13	5
2028	18	(9)	10	8	13	0	13	5
2029	18	(9)	10	8	13	0	13	5
2030	19	(9)	10	8	13	0	13	5
2031	19	(9)	10	8	13	0	13	5
2032	19	(9)	10	8	13	0	13	5
2033	19	(9)	10	8	13	0	13	5
2034	19	(9)	10	8	13	0	13	5
2035	19	(9)	10	8	13	0	13	5
2036	19	(9)	10	8	13	0	13	5
2037	19	(9)	10	8	13	0	13	5
2038	19	(9)	9	8	13	0	13	5
2039	19	(9)	9	8	13	0	13	5
2040	19	(9)	9	8	13	0	13	5

3. Rain Barrels
    a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Temple Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Temple's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Temple's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Temple's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Temple with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	165	26	192	132	0	132	59
2016	168	27	195	165	0	165	29
2017	170	27	198	165	0	165	32
2018	173	28	201	199	0	199	2
2019	175	28	204	232	0	232	(28)
2020	178	29	207	298	0	298	(91)
2021	180	29	210	357	0	357	(148)
2022	183	30	213	417	0	417	(204)
2023	185	30	215	476	0	476	(261)
2024	188	31	218	536	0	536	(317)
2025	190	31	221	595	0	595	(374)
2026	193	32	224	655	0	655	(431)
2027	195	32	227	714	0	714	(487)
2028	198	33	230	774	0	774	(544)
2029	200	33	233	833	0	833	(600)
2030	202	33	236	893	0	893	(657)
2031	205	34	239	967	0	967	(728)
2032	208	34	242	1,041	0	1,041	(799)
2033	211	35	246	1,115	0	1,115	(870)
2034	213	35	249	1,190	0	1,190	(941)
2035	216	36	252	1,264	0	1,264	(1,011)
2036	219	36	255	1,338	0	1,338	(1,082)
2037	222	37	259	1,412	0	1,412	(1,153)
2038	225	37	262	1,486	0	1,486	(1,224)
2039	227	38	265	1,560	0	1,560	(1,295)
2040	230	38	269	1,634	0	1,634	(1,366)
2041	233	39	272	1,723	0	1,723	(1,451)
2042	236	39	275	1,811	0	1,811	(1,536)
2043	239	40	279	1,899	0	1,899	(1,620)
2044	242	41	282	1,988	0	1,988	(1,705)
2045	245	41	286	2,076	0	2,076	(1,790)
2046	248	42	289	2,164	0	2,164	(1,875)
2047	251	42	293	2,252	0	2,252	(1,960)
2048	253	43	296	2,341	0	2,341	(2,045)
2049	256	43	299	2,429	0	2,429	(2,130)
2050	259	44	303	2,517	0	2,517	(2,214)
2051	262	44	306	2,617	0	2,617	(2,310)
2052	265	45	310	2,716	0	2,716	(2,406)
2053	268	45	313	2,815	0	2,815	(2,502)
2054	271	46	317	2,914	0	2,914	(2,598)
2055	274	46	320	3,014	0	3,014	(2,694)
2056	277	47	324	3,113	0	3,113	(2,790)
2057	280	47	327	3,212	0	3,212	(2,885)
2058	283	48	330	3,312	0	3,312	(2,981)
2059	286	48	334	3,411	0	3,411	(3,077)
2060	289	49	337	3,510	0	3,510	(3,173)
2061	292	49	341	3,545	0	3,545	(3,205)
2062	295	50	344	3,581	0	3,581	(3,236)
2063	298	50	348	3,616	0	3,616	(3,268)
2064	300	51	351	3,651	0	3,651	(3,300)
2065	303	51	354	3,686	0	3,686	(3,332)
2066	306	52	358	3,721	0	3,721	(3,363)
2067	309	52	361	3,756	0	3,756	(3,395)
2068	312	53	365	3,792	0	3,792	(3,427)
2069	315	53	368	3,827	0	3,827	(3,459)
2070	318	54	371	3,862	0	3,862	(3,490)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Temple's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	217	0	0	0
1	2015	72,277	207	259	192	(67)
2	2016	73,672	197	527	195	(332)
3	2017	75,067	188	806	198	(608)
4	2018	76,463	178	1,094	201	(893)
5-year Goal	2019	77,858	168	1,392	204	(1,189)
6	2020	79,253	166	1,464	207	(1,257)
7	2021	80,504	165	1,534	210	(1,324)
8	2022	81,754	163	1,605	213	(1,393)
9	2023	83,005	162	1,678	215	(1,463)
10-year Goal	2024	84,255	160	1,753	218	(1,535)

13 In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Temple's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2015	72,277	18.20	21	26	5
2	2016	73,672	17.40	43	27	(16)
3	2017	75,067	16.60	66	27	(38)
4	2018	76,463	15.80	89	28	(61)
5-year Goal	2019	77,858	15.00	114	28	(85)
6	2020	79,253	14.80	121	29	(93)
7	2021	80,504	14.60	129	29	(100)
8	2022	81,754	14.40	137	30	(107)
9	2023	83,005	14.20	145	30	(115)
10-year Goal	2024	84,255	14.00	154	31	(123)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 26 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 14.0% increase in 2014
    b. Estimated customer demand reduction of 2.8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

[17] Correspondence with utility staff.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013	160	160.0
2014	163	163.0
2015	165	165.5
2016	168	167.9
2017	170	170.4
2018	173	172.9
2019	175	175.3
2020	178	177.8
2021	180	180.3
2022	183	182.7
2023	185	185.2
2024	188	187.7
2025	190	190.1
2026	193	192.6
2027	195	195.1
2028	198	197.5
2029	200	200.0
2030	202	202.5
2031	205	205.2
2032	208	208.0
2033	211	210.7
2034	213	213.5
2035	216	216.3
2036	219	219.0
2037	222	221.8
2038	225	224.5
2039	227	227.3
2040	230	230.1
2041	233	233.0
2042	236	235.9
2043	239	238.8
2044	242	241.8
2045	245	244.7
2046	248	247.6
2047	251	250.5
2048	253	253.4
2049	256	256.4
2050	259	259.3
2051	262	262.2
2052	265	265.2
2053	268	268.1
2054	271	271.1
2055	274	274.0
2056	277	277.0
2057	280	279.9
2058	283	282.9
2059	286	285.8
2060	289	288.8
2061	292	291.7
2062	295	294.6
2063	298	297.5
2064	300	300.4
2065	303	303.3
2066	306	306.3
2067	309	309.2
2068	312	312.1
2069	315	315.0
2070	318	317.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	19.00	0
2015	72,277	18.00	26
2016	73,672	18.00	27
2017	75,067	18.00	27
2018	76,463	18.00	28
2019	77,858	18.00	28
2020	79,253	18.00	29
2021	80,504	18.00	29
2022	81,754	18.00	30
2023	83,005	18.00	30
2024	84,255	18.00	31

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 8% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    b. Savings could be 480 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	168	27	195	480	165	0	165	509
2017	170	27	198	487	165	0	165	519
2018	173	28	201	494	199	0	199	496
2019	175	28	204	501	232	0	232	473
2020	178	29	207	508	298	0	298	417
2021	180	29	210	515	357	0	357	367
2022	183	30	213	522	417	0	417	318
2023	185	30	215	529	476	0	476	268
2024	188	31	218	536	536	0	536	219
2025	190	31	221	543	595	0	595	169
2026	193	32	224	550	655	0	655	120
2027	195	32	227	557	714	0	714	70
2028	198	33	230	564	774	0	774	21
2029	200	33	233	571	833	0	833	(29)
2030	202	33	236	578	893	0	893	(79)
2031	205	34	239	586	967	0	967	(142)
2032	208	34	242	594	1,041	0	1,041	(205)
2033	211	35	246	602	1,115	0	1,115	(268)
2034	213	35	249	610	1,190	0	1,190	(331)
2035	216	36	252	618	1,264	0	1,264	(394)
2036	219	36	255	626	1,338	0	1,338	(457)
2037	222	37	259	634	1,412	0	1,412	(520)
2038	225	37	262	642	1,486	0	1,486	(583)
2039	227	38	265	649	1,560	0	1,560	(646)
2040	230	38	269	657	1,634	0	1,634	(709)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	168	27	195	80	165	0	165	110
2017	170	27	198	82	165	0	165	114
2018	173	28	201	83	199	0	199	85
2019	175	28	204	84	232	0	232	56
2020	178	29	207	85	298	0	298	(6)
2021	180	29	210	86	357	0	357	(61)
2022	183	30	213	87	417	0	417	(117)
2023	185	30	215	89	476	0	476	(172)
2024	188	31	218	90	536	0	536	(228)
2025	190	31	221	91	595	0	595	(283)
2026	193	32	224	92	655	0	655	(339)
2027	195	32	227	93	714	0	714	(394)
2028	198	33	230	95	774	0	774	(449)
2029	200	33	233	96	833	0	833	(505)
2030	202	33	236	97	893	0	893	(560)
2031	205	34	239	98	967	0	967	(630)
2032	208	34	242	100	1,041	0	1,041	(699)
2033	211	35	246	101	1,115	0	1,115	(769)
2034	213	35	249	102	1,190	0	1,190	(838)
2035	216	36	252	103	1,264	0	1,264	(908)
2036	219	36	255	105	1,338	0	1,338	(978)
2037	222	37	259	106	1,412	0	1,412	(1,047)
2038	225	37	262	107	1,486	0	1,486	(1,117)
2039	227	38	265	109	1,560	0	1,560	(1,186)
2040	230	38	269	110	1,634	0	1,634	(1,256)

3. Rain Barrels
   a. In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Waco Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Waco's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Waco's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Waco's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Waco with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(966)	(966)	212	0	212	(1,178)
2016	163	(968)	(805)	265	0	265	(1,070)
2017	437	(970)	(533)	265	0	265	(798)
2018	440	(972)	(533)	318	0	318	(850)
2019	442	(974)	(532)	371	0	371	(903)
2020	444	(977)	(532)	476	0	476	(1,008)
2021	447	(984)	(537)	560	0	560	(1,097)
2022	449	(992)	(542)	644	0	644	(1,186)
2023	452	(999)	(547)	728	0	728	(1,275)
2024	454	(1,007)	(552)	812	0	812	(1,364)
2025	457	(1,014)	(558)	895	0	895	(1,453)
2026	459	(1,022)	(563)	979	0	979	(1,542)
2027	462	(1,029)	(568)	1,063	0	1,063	(1,631)
2028	464	(1,037)	(573)	1,147	0	1,147	(1,720)
2029	467	(1,045)	(578)	1,231	0	1,231	(1,808)
2030	469	(1,052)	(583)	1,314	0	1,314	(1,897)
2031	471	(1,059)	(587)	1,404	0	1,404	(1,991)
2032	474	(1,066)	(592)	1,493	0	1,493	(2,085)
2033	476	(1,072)	(596)	1,583	0	1,583	(2,179)
2034	478	(1,079)	(601)	1,673	0	1,673	(2,273)
2035	480	(1,086)	(605)	1,762	0	1,762	(2,367)
2036	483	(1,092)	(610)	1,852	0	1,852	(2,461)
2037	485	(1,099)	(614)	1,941	0	1,941	(2,555)
2038	487	(1,106)	(619)	2,031	0	2,031	(2,649)
2039	489	(1,112)	(623)	2,120	0	2,120	(2,743)
2040	491	(1,119)	(628)	2,210	0	2,210	(2,837)
2041	494	(1,126)	(632)	2,308	0	2,308	(2,939)
2042	496	(1,132)	(636)	2,405	0	2,405	(3,041)
2043	499	(1,139)	(640)	2,503	0	2,503	(3,143)
2044	501	(1,146)	(644)	2,601	0	2,601	(3,245)
2045	504	(1,153)	(649)	2,699	0	2,699	(3,347)
2046	507	(1,159)	(653)	2,797	0	2,797	(3,449)
2047	509	(1,166)	(657)	2,894	0	2,894	(3,551)
2048	512	(1,173)	(661)	2,992	0	2,992	(3,653)
2049	514	(1,179)	(665)	3,090	0	3,090	(3,755)
2050	517	(1,186)	(670)	3,188	0	3,188	(3,857)
2051	519	(1,193)	(674)	3,258	0	3,258	(3,932)
2052	522	(1,200)	(678)	3,328	0	3,328	(4,006)
2053	525	(1,206)	(681)	3,399	0	3,399	(4,080)
2054	528	(1,213)	(685)	3,469	0	3,469	(4,154)
2055	530	(1,220)	(689)	3,539	0	3,539	(4,229)
2056	533	(1,226)	(693)	3,610	0	3,610	(4,303)
2057	536	(1,233)	(697)	3,680	0	3,680	(4,377)
2058	539	(1,240)	(701)	3,751	0	3,751	(4,452)
2059	541	(1,246)	(705)	3,821	0	3,821	(4,526)
2060	544	(1,253)	(709)	3,891	0	3,891	(4,600)
2061	547	(1,260)	(713)	3,911	0	3,911	(4,624)
2062	550	(1,266)	(717)	3,931	0	3,931	(4,648)
2063	553	(1,273)	(720)	3,951	0	3,951	(4,672)
2064	555	(1,279)	(724)	3,971	0	3,971	(4,695)
2065	558	(1,286)	(728)	3,991	0	3,991	(4,719)
2066	561	(1,293)	(732)	4,011	0	4,011	(4,743)
2067	564	(1,299)	(736)	4,031	0	4,031	(4,767)
2068	566	(1,306)	(739)	4,051	0	4,051	(4,791)
2069	569	(1,312)	(743)	4,071	0	4,071	(4,815)
2070	572	(1,319)	(747)	4,091	0	4,091	(4,838)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Waco's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	225	0	0	0
1	2,015	132,356	224	39	(966)	(1,005)
2	2,016	132,639	223	77	(805)	(883)
3	2,017	132,921	223	116	(533)	(650)
4	2,018	133,204	222	156	(533)	(688)
5-year Goal	2,019	133,486	221	195	(532)	(727)
6	2,020	133,769	216	439	(532)	(971)
7	2,021	134,805	211	689	(537)	(1,226)
8	2,022	135,842	206	942	(542)	(1,484)
9	2,023	136,878	201	1,199	(547)	(1,746)
10-year Goal	2,024	137,914	196	1,460	(552)	(2,012)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Waco's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2,015	132,356	18	29	(966)	(995)
2	2,016	132,639	18	58	(968)	(1,026)
3	2,017	132,921	17	87	(970)	(1,058)
4	2,018	133,204	17	117	(972)	(1,089)
5-year Goal	2,019	133,486	16	146	(974)	(1,121)
6	2,020	133,769	16	156	(977)	(1,133)
7	2,021	134,805	16	167	(984)	(1,151)
8	2,022	135,842	15	178	(992)	(1,170)
9	2,023	136,878	15	190	(999)	(1,189)
10-year Goal	2,024	137,914	15	201	(1,007)	(1,208)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 966 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 7.4% increase in 2016
        ii. 13.9% increase in 2017
    b. Estimated customer demand reduction of 4.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Save Water Co. Commercial, Multi-family and Hotel Programs[19]

a. Project initiated in service area in 2016.
b. Save Water completed work on 326 multi-family units in 2016.
c. Average monthly savings of 1,024,357 gallons
d. Annualized savings of 12.3 MG for the life of the retrofitted fixtures
e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
    i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Save Water Co.	TOTAL SAVINGS
2012			0
2013			0
2014			0
2015			0
2016	151	12.3	163.1
2017	425	12.3	437.1
2018	427	12.3	439.6
2019	430	12.3	442.0
2020	432	12.3	444.5
2021	435	12.3	447.0
2022	437	12.3	449.4
2023	440	12.3	451.9
2024	442	12.3	454.4
2025	445	12.3	456.8
2026	447	12.3	459.3
2027	449	12.3	461.8
2028	452	12.3	464.2
2029	454	12.3	466.7
2030	457	12.3	469.1
2031	459	12.3	471.4
2032	461	12.3	473.6
2033	464	12.3	475.8
2034	466	12.3	478.1
2035	468	12.3	480.3
2036	470	12.3	482.5
2037	472	12.3	484.7
2038	475	12.3	487.0
2039	477	12.3	489.2
2040	479	12.3	491.4
2041	482	12.3	493.9
2042	484	12.3	496.5
2043	487	12.3	499.0
2044	489	12.3	501.5
2045	492	12.3	504.0
2046	494	12.3	506.5
2047	497	12.3	509.0
2048	499	12.3	511.5
2049	502	12.3	514.0
2050	504	12.3	516.6
2051	507	12.3	519.3
2052	510	12.3	522.1
2053	513	12.3	524.8
2054	515	12.3	527.6
2055	518	12.3	530.4
2056	521	12.3	533.1
2057	524	12.3	535.9
2058	526	12.3	538.7
2059	529	12.3	541.4
2060	532	12.3	544.2
2061	535	12.3	547.0
2062	537	12.3	549.8
2063	540	12.3	552.5
2064	543	12.3	555.3
2065	546	12.3	558.1
2066	549	12.3	560.9
2067	551	12.3	563.6
2068	554	12.3	566.4
2069	557	12.3	569.2
2070	560	12.3	571.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	19.00	0
2015	132,356	39.00	(966)
2016	132,639	39.00	(968)
2017	132,921	39.00	(970)
2018	133,204	39.00	(972)
2019	133,486	39.00	(974)
2020	133,769	39.00	(977)
2021	134,805	39.00	(984)
2022	135,842	39.00	(992)
2023	136,878	39.00	(999)
2024	137,914	39.00	(1,007)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.37% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 741 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	163	(968)	(805)	741	265	0	265	(329)
2017	437	(970)	(533)	745	265	0	265	(52)
2018	440	(972)	(533)	750	318	0	318	(101)
2019	442	(974)	(532)	754	371	0	371	(149)
2020	444	(977)	(532)	758	476	0	476	(250)
2021	447	(984)	(537)	763	560	0	560	(335)
2022	449	(992)	(542)	767	644	0	644	(419)
2023	452	(999)	(547)	771	728	0	728	(504)
2024	454	(1,007)	(552)	776	812	0	812	(588)
2025	457	(1,014)	(558)	780	895	0	895	(673)
2026	459	(1,022)	(563)	784	979	0	979	(757)
2027	462	(1,029)	(568)	789	1,063	0	1,063	(842)
2028	464	(1,037)	(573)	793	1,147	0	1,147	(927)
2029	467	(1,045)	(578)	797	1,231	0	1,231	(1,011)
2030	469	(1,052)	(583)	802	1,314	0	1,314	(1,096)
2031	471	(1,059)	(587)	806	1,404	0	1,404	(1,186)
2032	474	(1,066)	(592)	809	1,493	0	1,493	(1,276)
2033	476	(1,072)	(596)	813	1,583	0	1,583	(1,366)
2034	478	(1,079)	(601)	817	1,673	0	1,673	(1,456)
2035	480	(1,086)	(605)	821	1,762	0	1,762	(1,546)
2036	483	(1,092)	(610)	825	1,852	0	1,852	(1,636)
2037	485	(1,099)	(614)	829	1,941	0	1,941	(1,726)
2038	487	(1,106)	(619)	833	2,031	0	2,031	(1,817)
2039	489	(1,112)	(623)	837	2,120	0	2,120	(1,907)
2040	491	(1,119)	(628)	841	2,210	0	2,210	(1,997)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	163	(968)	(805)	135	265	0	265	(935)
2017	437	(970)	(533)	136	265	0	265	(662)
2018	440	(972)	(533)	136	318	0	318	(714)
2019	442	(974)	(532)	137	371	0	371	(766)
2020	444	(977)	(532)	138	476	0	476	(871)
2021	447	(984)	(537)	139	560	0	560	(959)
2022	449	(992)	(542)	139	644	0	644	(1,047)
2023	452	(999)	(547)	140	728	0	728	(1,135)
2024	454	(1,007)	(552)	141	812	0	812	(1,223)
2025	457	(1,014)	(558)	142	895	0	895	(1,311)
2026	459	(1,022)	(563)	143	979	0	979	(1,399)
2027	462	(1,029)	(568)	143	1,063	0	1,063	(1,487)
2028	464	(1,037)	(573)	144	1,147	0	1,147	(1,575)
2029	467	(1,045)	(578)	145	1,231	0	1,231	(1,664)
2030	469	(1,052)	(583)	146	1,314	0	1,314	(1,752)
2031	471	(1,059)	(587)	146	1,404	0	1,404	(1,845)
2032	474	(1,066)	(592)	147	1,493	0	1,493	(1,938)
2033	476	(1,072)	(596)	148	1,583	0	1,583	(2,032)
2034	478	(1,079)	(601)	149	1,673	0	1,673	(2,125)
2035	480	(1,086)	(605)	149	1,762	0	1,762	(2,218)
2036	483	(1,092)	(610)	150	1,852	0	1,852	(2,311)
2037	485	(1,099)	(614)	151	1,941	0	1,941	(2,405)
2038	487	(1,106)	(619)	151	2,031	0	2,031	(2,498)
2039	489	(1,112)	(623)	152	2,120	0	2,120	(2,591)
2040	491	(1,119)	(628)	153	2,210	0	2,210	(2,685)

3. Rain Barrel

- **a.** In Region G, utilities could save approximately 18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Woodway Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Woodway's current water conservation activities and their quantified savings to two metrics: 1) Region G Water Plan's (Texas Water Development Board, 2016f) recommended WMS supply volumes for municipal conservation, and 2) Woodway's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Woodway's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Woodway with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	5.5	32	38	30	0	30	7
2016	22.1	32	54	38	0	38	17
2017	22.2	32	55	38	0	38	17
2018	22.4	33	55	45	0	45	10
2019	22.5	33	55	53	0	53	3
2020	22.7	33	56	68	0	68	(12)
2021	22.8	33	56	78	0	78	(21)
2022	23.0	34	57	88	0	88	(31)
2023	23.1	34	57	98	0	98	(40)
2024	23.3	34	57	107	0	107	(50)
2025	23.4	34	58	117	0	117	(59)
2026	23.5	35	58	127	0	127	(69)
2027	23.7	35	59	137	0	137	(78)
2028	23.8	35	59	147	0	147	(88)
2029	24.0	35	59	157	0	157	(97)
2030	24.1	36	60	167	0	167	(107)
2031	24.3	36	60	177	0	177	(117)
2032	24.4	36	61	188	0	188	(127)
2033	24.5	36	61	198	0	198	(137)
2034	24.7	37	61	209	0	209	(147)
2035	24.8	37	62	219	0	219	(157)
2036	24.9	37	62	229	0	229	(167)
2037	25.1	37	62	240	0	240	(177)
2038	25.2	38	63	250	0	250	(187)
2039	25.3	38	63	261	0	261	(198)
2040	25.5	38	64	271	0	271	(208)
2041	25.6	38	64	282	0	282	(219)
2042	25.7	39	64	294	0	294	(230)
2043	25.9	39	65	305	0	305	(241)
2044	26.0	39	65	317	0	317	(251)
2045	26.2	39	65	328	0	328	(262)
2046	26.3	39	66	339	0	339	(273)
2047	26.5	40	66	351	0	351	(284)
2048	26.6	40	67	362	0	362	(295)
2049	26.8	40	67	373	0	373	(306)
2050	26.9	40	67	385	0	385	(317)
2051	27.1	41	68	396	0	396	(329)
2052	27.2	41	68	408	0	408	(340)
2053	27.4	41	68	420	0	420	(351)
2054	27.5	41	69	432	0	432	(363)
2055	27.7	42	69	443	0	443	(374)
2056	27.8	42	70	455	0	455	(386)
2057	28.0	42	70	467	0	467	(397)
2058	28.1	42	70	479	0	479	(408)
2059	28.3	43	71	490	0	490	(420)
2060	28.4	43	71	502	0	502	(431)
2061	28.6	43	72	514	0	514	(443)
2062	28.7	43	72	526	0	526	(454)
2063	28.9	43	72	538	0	538	(466)
2064	29.0	44	73	550	0	550	(477)
2065	29.2	44	73	562	0	562	(489)
2066	29.3	44	73	574	0	574	(500)
2067	29.5	44	74	585	0	585	(512)
2068	29.6	45	74	597	0	597	(523)
2069	29.8	45	75	609	0	609	(535)
2070	29.9	45	75	621	0	621	(546)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Woodway's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	288	0	0	0
1	2015	8,777	285	9	38	29
2	2016	8,837	282	18	54	36
3	2017	8,896	280	27	55	27
4	2018	8,956	277	37	55	18
5-year Goal	2019	9,015	274	46	55	9
6	2020	9,075	271	56	56	0
7	2021	9,147	268	65	56	(9)
8	2022	9,219	266	75	57	(19)
9	2023	9,291	263	85	57	(28)
10-year Goal	2024	9,363	260	96	57	(38)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Woodway's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	63.00	0	0	0
1	2015	8,777	62.40	2	32	30
2	2016	8,837	61.80	4	32	28
3	2017	8,896	61.20	6	32	27
4	2018	8,956	60.60	8	33	25
5-year Goal	2019	9,015	60.00	10	33	23
6	2020	9,075	59.60	11	33	22
7	2021	9,147	59.20	13	33	21
8	2022	9,219	58.80	14	34	20
9	2023	9,291	58.40	16	34	18
10-year Goal	2024	9,363	58.00	17	34	17

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 32 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 2.7% increase in 2015
        ii. 7.1% increase in 2016
    b. Estimated customer demand reduction of 2.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0.0
2010		0.0
2011		0.0
2012		0.0
2013		0.0
2014		0.0
2015	5.5	5.5
2016	22.1	22.1
2017	22.2	22.2
2018	22.4	22.4
2019	22.5	22.5
2020	22.7	22.7
2021	22.8	22.8
2022	23.0	23.0
2023	23.1	23.1
2024	23.3	23.3
2025	23.4	23.4
2026	23.5	23.5
2027	23.7	23.7
2028	23.8	23.8
2029	24.0	24.0
2030	24.1	24.1
2031	24.3	24.3
2032	24.4	24.4
2033	24.5	24.5
2034	24.7	24.7
2035	24.8	24.8
2036	24.9	24.9
2037	25.1	25.1
2038	25.2	25.2
2039	25.3	25.3
2040	25.5	25.5
2041	25.6	25.6
2042	25.7	25.7
2043	25.9	25.9
2044	26.0	26.0
2045	26.2	26.2
2046	26.3	26.3
2047	26.5	26.5
2048	26.6	26.6
2049	26.8	26.8
2050	26.9	26.9
2051	27.1	27.1
2052	27.2	27.2
2053	27.4	27.4
2054	27.5	27.5
2055	27.7	27.7
2056	27.8	27.8
2057	28.0	28.0
2058	28.1	28.1
2059	28.3	28.3
2060	28.4	28.4
2061	28.6	28.6
2062	28.7	28.7
2063	28.9	28.9
2064	29.0	29.0
2065	29.2	29.2
2066	29.3	29.3
2067	29.5	29.5
2068	29.6	29.6
2069	29.8	29.8
2070	29.9	29.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	63.00	0
2015	8,777	53.00	32
2016	8,837	53.00	32
2017	8,896	53.00	32
2018	8,956	53.00	33
2019	9,015	53.00	33
2020	9,075	53.00	33
2021	9,147	53.00	33
2022	9,219	53.00	34
2023	9,291	53.00	34
2024	9,363	53.00	34

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 7.58% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region G savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 84 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	32	54	84	38	0	38	100
2017	22	32	55	84	38	0	38	101
2018	22	33	55	85	45	0	45	95
2019	23	33	55	85	53	0	53	88
2020	23	33	56	86	68	0	68	74
2021	23	33	56	86	78	0	78	65
2022	23	34	57	87	88	0	88	56
2023	23	34	57	88	98	0	98	47
2024	23	34	57	88	107	0	107	38
2025	23	34	58	89	117	0	117	29
2026	24	35	58	89	127	0	127	20
2027	24	35	59	90	137	0	137	11
2028	24	35	59	90	147	0	147	2
2029	24	35	59	91	157	0	157	(7)
2030	24	36	60	91	167	0	167	(15)
2031	24	36	60	92	177	0	177	(25)
2032	24	36	61	92	188	0	188	(35)
2033	25	36	61	93	198	0	198	(44)
2034	25	37	61	93	209	0	209	(54)
2035	25	37	62	94	219	0	219	(63)
2036	25	37	62	94	229	0	229	(73)
2037	25	37	62	95	240	0	240	(82)
2038	25	38	63	95	250	0	250	(92)
2039	25	38	63	96	261	0	261	(102)
2040	25	38	64	96	271	0	271	(111)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	32	54	15	38	0	38	31
2017	22	32	55	15	38	0	38	32
2018	22	33	55	15	45	0	45	25
2019	23	33	55	15	53	0	53	18
2020	23	33	56	15	68	0	68	3
2021	23	33	56	15	78	0	78	(6)
2022	23	34	57	15	88	0	88	(16)
2023	23	34	57	15	98	0	98	(25)
2024	23	34	57	16	107	0	107	(34)
2025	23	34	58	16	117	0	117	(44)
2026	24	35	58	16	127	0	127	(53)
2027	24	35	59	16	137	0	137	(63)
2028	24	35	59	16	147	0	147	(72)
2029	24	35	59	16	157	0	157	(81)
2030	24	36	60	16	167	0	167	(91)
2031	24	36	60	16	177	0	177	(101)
2032	24	36	61	16	188	0	188	(111)
2033	25	36	61	16	198	0	198	(121)
2034	25	37	61	17	209	0	209	(131)
2035	25	37	62	17	219	0	219	(141)
2036	25	37	62	17	229	0	229	(151)
2037	25	37	62	17	240	0	240	(161)
2038	25	38	63	17	250	0	250	(171)
2039	25	38	63	17	261	0	261	(181)
2040	25	38	64	17	271	0	271	(191)

3. Rain Barrels
    a. In Region G, utilities could save approximately18.5 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Region H Individual Reports

Statewide Water Conservation Quantification Project
City of Baytown Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Baytown's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Baytown's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Baytown's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility’s

---

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be include in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) In Regional Water Plan

Table 3-1 shows the 2070 outlook for Baytown with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes,

---

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	16.6	213	230	11	20	31	198
2016	16.7	214	231	14	25	39	191
2017	15.1	215	230	14	30	44	186
2018	13.3	216	229	17	35	52	177
2019	11.3	217	228	19	41	60	168
2020	9.6	218	228	25	46	70	157
2021	7.9	219	227	29	50	79	148
2022	7.9	220	228	34	54	87	140
2023	7.9	221	229	38	58	96	133
2024	7.9	222	229	43	62	105	125
2025	7.9	222	230	47	66	113	117
2026	7.9	223	231	52	70	122	109
2027	7.9	223	231	56	74	130	101
2028	7.9	224	232	60	78	139	93
2029	7.9	224	232	65	82	147	85
2030	7.9	225	233	69	86	156	77
2031	7.9	226	233	73	90	163	70
2032	7.9	226	234	77	94	171	63
2033	7.9	227	235	81	97	179	56
2034	7.9	227	235	85	101	187	49
2035	7.9	228	236	89	105	194	42
2036	7.9	229	237	93	108	202	35
2037	7.9	229	237	97	112	210	28
2038	7.9	230	238	101	116	217	20
2039	7.9	231	238	105	120	225	13
2040	7.9	231	239	110	123	233	6
2041	7.9	232	240	113	126	239	1
2042	7.9	232	240	117	128	245	(4)
2043	7.9	233	241	121	130	251	(10)
2044	7.9	234	242	124	132	257	(15)
2045	7.9	234	242	128	135	263	(20)
2046	7.9	235	243	132	137	269	(26)
2047	7.9	236	244	135	139	275	(31)
2048	7.9	236	244	139	142	281	(36)
2049	7.9	237	245	143	144	287	(42)
2050	7.9	238	245	146	146	293	(47)
2051	7.9	238	246	150	147	297	(50)
2052	7.9	239	247	153	147	300	(54)
2053	7.9	240	247	157	148	304	(57)
2054	7.9	240	248	160	148	308	(60)
2055	7.9	241	249	164	148	312	(63)
2056	7.9	242	249	167	149	316	(66)
2057	7.9	242	250	171	149	320	(70)
2058	7.9	243	251	174	149	324	(73)
2059	7.9	244	252	178	150	328	(76)
2060	7.9	244	252	181	150	331	(79)
2061	7.9	245	253	184	151	335	(82)
2062	7.9	246	254	188	151	339	(85)
2063	7.9	246	254	191	152	342	(88)
2064	7.9	247	255	194	152	346	(91)
2065	7.9	248	256	197	152	350	(94)
2066	7.9	248	256	201	153	354	(97)
2067	7.9	249	257	204	153	357	(100)
2068	7.9	250	258	207	154	361	(103)
2069	7.9	251	258	211	154	365	(106)
2070	7.9	251	259	214	154	368	(109)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Baytown's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	149	0	0	0
1	2015	73,950	147	59	230	170
2	2016	74,298	145	119	231	111
3	2017	74,646	142	180	230	50
4	2018	74,993	140	241	229	-12
5-year Goal	2019	75,341	138	302	228	(74)
6	2020	75,689	137	326	228	(98)
7	2021	75,887	136	349	227	(122)
8	2022	76,084	136	372	228	(144)
9	2023	76,282	135	395	229	(166)
10-year Goal	2024	76,480	134	419	229	(189)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Baytown's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	30.00	0	0	0
1	2015	73,950	29.40	16	213	197
2	2016	74,298	28.80	33	214	181
3	2017	74,646	28.20	49	215	166
4	2018	74,993	27.60	66	216	150
5-year Goal	2019	75,341	27.00	82	217	134
6	2020	75,689	26.60	94	218	124
7	2021	75,887	26.20	105	219	114
8	2022	76,084	25.80	117	220	103
9	2023	76,282	25.40	128	221	93
10-year Goal	2024	76,480	25.00	140	222	82

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
   a. Savings of 213 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **WaterWise Take-home Kits**
   a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
   b. Conservative 5-year useful life for all items in kit
   c. 15% adoption rate assumed

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6. **Save Water Co. Commercial, Multi-family and Hotel Programs**[16]
    a. Project initiated in service area in 2015
    b. Save Water completed work on 220 multi-family units in 2015
    c. Average monthly savings of 655,345 gallons
    d. Annualized savings of 7.86 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
        i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[16] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	Save Water Co. Program	TOTAL SAVINGS
2009	1.8		1.8
2010	3.3		3.3
2011	5.1		5.1
2012	6.7		6.7
2013	8.5		8.5
2014	8.6		8.6
2015	8.8	7.9	16.6
2016	8.8	7.9	16.7
2017	7.2	7.9	15.1
2018	5.4	7.9	13.3
2019	3.5	7.9	11.3
2020	1.7	7.9	9.6
2021		7.9	7.9
2022		7.9	7.9
2023		7.9	7.9
2024		7.9	7.9
2025		7.9	7.9
2026		7.9	7.9
2027		7.9	7.9
2028		7.9	7.9
2029		7.9	7.9
2030		7.9	7.9
2031		7.9	7.9
2032		7.9	7.9
2033		7.9	7.9
2034		7.9	7.9
2035		7.9	7.9
2036		7.9	7.9
2037		7.9	7.9
2038		7.9	7.9
2039		7.9	7.9
2040		7.9	7.9
2041		7.9	7.9
2042		7.9	7.9
2043		7.9	7.9
2044		7.9	7.9
2045		7.9	7.9
2046		7.9	7.9
2047		7.9	7.9
2048		7.9	7.9
2049		7.9	7.9
2050		7.9	7.9
2051		7.9	7.9
2052		7.9	7.9
2053		7.9	7.9
2054		7.9	7.9
2055		7.9	7.9
2056		7.9	7.9
2057		7.9	7.9
2058		7.9	7.9
2059		7.9	7.9
2060		7.9	7.9
2061		7.9	7.9
2062		7.9	7.9
2063		7.9	7.9
2064		7.9	7.9
2065		7.9	7.9
2066		7.9	7.9
2067		7.9	7.9
2068		7.9	7.9
2069		7.9	7.9
2070		7.9	7.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	30.00	0
2015	72,899	22.00	213
2016	73,250	22.00	214
2017	73,600	22.00	215
2018	73,950	22.00	216
2019	74,298	22.00	217
2020	74,646	22.00	218
2021	74,993	22.00	219
2022	75,341	22.00	220
2023	75,689	22.00	221
2024	75,887	22.00	222

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 133 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	214	231	133	14	25	39	324
2017	15	215	230	133	14	30	44	318
2018	13	216	229	133	17	35	52	310
2019	11	217	228	132	19	41	60	301
2020	10	218	228	132	25	46	70	289
2021	8	219	227	132	29	50	79	280
2022	8	220	228	132	34	54	87	273
2023	8	221	229	132	38	58	96	265
2024	8	222	229	132	43	62	105	257
2025	8	222	230	132	47	66	113	249
2026	8	223	231	132	52	70	122	241
2027	8	223	231	132	56	74	130	233
2028	8	224	232	132	60	78	139	225
2029	8	224	232	131	65	82	147	217
2030	8	225	233	131	69	86	156	208
2031	8	226	233	131	73	90	163	201
2032	8	226	234	131	77	94	171	194
2033	8	227	235	131	81	97	179	187
2034	8	227	235	131	85	101	187	180
2035	8	228	236	131	89	105	194	173
2036	8	229	237	131	93	108	202	166
2037	8	229	237	131	97	112	210	159
2038	8	230	238	131	101	116	217	152
2039	8	231	238	131	105	120	225	145
2040	8	231	239	131	110	123	233	138

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	214	231	44	14	25	39	236
2017	15	215	230	44	14	30	44	230
2018	13	216	229	44	17	35	52	222
2019	11	217	228	44	19	41	60	213
2020	10	218	228	44	25	46	70	201
2021	8	219	227	44	29	50	79	192
2022	8	220	228	44	34	54	87	185
2023	8	221	229	44	38	58	96	177
2024	8	222	229	44	43	62	105	169
2025	8	222	230	44	47	66	113	161
2026	8	223	231	44	52	70	122	153
2027	8	223	231	44	56	74	130	145
2028	8	224	232	44	60	78	139	137
2029	8	224	232	44	65	82	147	129
2030	8	225	233	44	69	86	156	121
2031	8	226	233	44	73	90	163	114
2032	8	226	234	44	77	94	171	107
2033	8	227	235	44	81	97	179	100
2034	8	227	235	44	85	101	187	93
2035	8	228	236	44	89	105	194	86
2036	8	229	237	44	93	108	202	79
2037	8	229	237	44	97	112	210	72
2038	8	230	238	44	101	116	217	64
2039	8	231	238	44	105	120	225	57
2040	8	231	239	44	110	123	233	50

3. Water Rate Increase

- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 66 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	17	214	231	66	14	25	39	258
2017	15	215	230	66	14	30	44	252
2018	13	216	229	66	17	35	52	243
2019	11	217	228	66	19	41	60	235
2020	10	218	228	66	25	46	70	223
2021	8	219	227	66	29	50	79	214
2022	8	220	228	66	34	54	87	206
2023	8	221	229	66	38	58	96	199
2024	8	222	229	66	43	62	105	191
2025	8	222	230	66	47	66	113	183
2026	8	223	231	66	52	70	122	175
2027	8	223	231	66	56	74	130	167
2028	8	224	232	66	60	78	139	159
2029	8	224	232	66	65	82	147	151
2030	8	225	233	66	69	86	156	143
2031	8	226	233	66	73	90	163	136
2032	8	226	234	66	77	94	171	129
2033	8	227	235	66	81	97	179	121
2034	8	227	235	66	85	101	187	114
2035	8	228	236	66	89	105	194	107
2036	8	229	237	66	93	108	202	100
2037	8	229	237	66	97	112	210	93
2038	8	230	238	66	101	116	217	86
2039	8	231	238	66	105	120	225	79
2040	8	231	239	66	110	123	233	72

4. Rain Barrels

   a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Clute Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Clute's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Clute's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Clute's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantifed. Individual households

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be include in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) In Regional Water Plan

Table 3-1 shows the 2070 outlook for Clute with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.[11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1.3	12.4	14	2	3	5	9
2016	1.3	12.4	14	3	4	6	7
2017	1.1	12.5	14	3	4	7	6
2018	0.8	12.5	13	3	5	8	5
2019	0.5	12.5	13	4	6	10	3
2020	0.3	12.5	13	5	7	11	1
2021	0	12.6	13	6	7	13	(0)
2022	0	12.6	13	7	8	14	(2)
2023	0	12.7	13	7	8	16	(3)
2024	0	12.7	13	8	9	17	(4)
2025	0	12.7	13	9	9	19	(6)
2026	0	12.8	13	10	10	20	(7)
2027	0	12.8	13	11	11	21	(9)
2028	0	12.9	13	12	11	23	(10)
2029	0	12.9	13	13	12	24	(11)
2030	0	13.0	13	13	12	26	(13)
2031	0	13.0	13	14	13	27	(14)
2032	0	13.0	13	15	13	28	(15)
2033	0	13.1	13	16	14	30	(16)
2034	0	13.1	13	16	15	31	(18)
2035	0	13.2	13	17	15	32	(19)
2036	0	13.2	13	18	16	33	(20)
2037	0	13.3	13	18	16	35	(21)
2038	0	13.3	13	19	17	36	(23)
2039	0	13.4	13	20	17	37	(24)
2040	0	13.4	13	21	18	38	(25)
2041	0	13.5	13	21	18	39	(26)
2042	0	13.5	14	22	18	40	(27)
2043	0	13.6	14	22	19	41	(27)
2044	0	13.6	14	23	19	42	(28)
2045	0	13.7	14	23	19	43	(29)
2046	0	13.7	14	24	19	44	(30)
2047	0	13.8	14	25	20	44	(31)
2048	0	13.8	14	25	20	45	(31)
2049	0	13.9	14	26	20	46	(32)
2050	0	13.9	14	26	21	47	(33)
2051	0	14.0	14	27	21	47	(34)
2052	0	14.0	14	27	21	48	(34)
2053	0	14.1	14	28	21	49	(35)
2054	0	14.1	14	28	21	49	(35)
2055	0	14.2	14	29	21	50	(36)
2056	0	14.2	14	29	21	50	(36)
2057	0	14.3	14	30	21	51	(37)
2058	0	14.3	14	30	21	51	(37)
2059	0	14.4	14	31	21	52	(38)
2060	0	14.4	14	31	21	52	(38)
2061	0	14.5	14	32	21	53	(38)
2062	0	14.6	15	32	21	53	(39)
2063	0	14.6	15	33	21	54	(39)
2064	0	14.7	15	33	21	54	(40)
2065	0	14.7	15	33	22	55	(40)
2066	0	14.8	15	34	22	55	(41)
2067	0	14.8	15	34	22	56	(41)
2068	0	14.9	15	35	22	56	(41)
2069	0	15.0	15	35	22	57	(42)
2070	0	15.0	15	36	22	57	(42)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Clute's quantified savings from its implemented activities compare with 5- and 10-year and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	120	0	0	0
1	2015	11,328	115	19	14	(5)
2	2016	11,350	111	38	14	(24)
3	2017	11,373	106	57	14	(44)
4	2018	11,395	102	77	13	(63)
5-year Goal	2019	11,418	97	96	13	(83)
6	2020	11,440	95	104	13	(91)
7	2021	11,479	93	111	13	(99)
8	2022	11,518	92	119	13	(107)
9	2023	11,557	90	127	13	(115)
10-year Goal	2024	11,596	88	135	13	(123)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Clute's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	11,328	15.00	8	12.4	4
2	2016	11,350	13.00	17	12.4	(4)
3	2017	11,373	11.00	25	12.5	(12)
4	2018	11,395	9.00	33	12.5	(21)
5-year Goal	2019	11,418	7.00	42	12.5	(29)
6	2020	11,440	6.60	43	12.5	(31)
7	2021	11,479	6.20	45	12.6	(33)
8	2022	11,518	5.80	47	12.6	(34)
9	2023	11,557	5.40	49	12.7	(36)
10-year Goal	2024	11,596	5.00	51	12.7	(38)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of 12.4 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.3	0.3
2010	0.5	0.5
2011	0.8	0.8
2012	1.0	1.0
2013	1.3	1.3
2014	1.3	1.3
2015	1.3	1.3
2016	1.3	1.3
2017	1.1	1.1
2018	0.8	0.8
2019	0.5	0.5
2020	0.3	0.3
2021		0
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	11,328	14.00	12.4
2016	11,350	14.00	12.4
2017	11,373	14.00	12.5
2018	11,395	14.00	12.5
2019	11,418	14.00	12.5
2020	11,440	14.00	12.5
2021	11,479	14.00	12.6
2022	11,518	14.00	12.6
2023	11,557	14.00	12.7
2024	11,596	14.00	12.7

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 19 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	12	14	19	3	4	6	27
2017	1	12	14	19	3	4	7	26
2018	1	12	13	19	3	5	8	24
2019	1	13	13	19	4	6	10	23
2020	0	13	13	19	5	7	11	21
2021	0	13	13	19	6	7	13	19
2022	0	13	13	19	7	8	14	18
2023	0	13	13	19	7	8	16	16
2024	0	13	13	19	8	9	17	15
2025	0	13	13	19	9	9	19	13
2026	0	13	13	19	10	10	20	12
2027	0	13	13	19	11	11	21	11
2028	0	13	13	19	12	11	23	9
2029	0	13	13	19	13	12	24	8
2030	0	13	13	19	13	12	26	6
2031	0	13	13	19	14	13	27	5
2032	0	13	13	19	15	13	28	4
2033	0	13	13	19	16	14	30	3
2034	0	13	13	19	16	15	31	2
2035	0	13	13	19	17	15	32	0
2036	0	13	13	19	18	16	33	(1)
2037	0	13	13	19	18	16	35	(2)
2038	0	13	13	19	19	17	36	(3)
2039	0	13	13	19	20	17	37	(4)
2040	0	13	13	19	21	18	38	(6)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[16]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[16] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	12	14	6	3	4	6	14
2017	1	12	14	6	3	4	7	13
2018	1	12	13	6	3	5	8	11
2019	1	13	13	6	4	6	10	10
2020	0	13	13	6	5	7	11	8
2021	0	13	13	6	6	7	13	6
2022	0	13	13	6	7	8	14	5
2023	0	13	13	6	7	8	16	3
2024	0	13	13	6	8	9	17	2
2025	0	13	13	6	9	9	19	1
2026	0	13	13	6	10	10	20	(1)
2027	0	13	13	6	11	11	21	(2)
2028	0	13	13	6	12	11	23	(4)
2029	0	13	13	6	13	12	24	(5)
2030	0	13	13	6	13	12	26	(6)
2031	0	13	13	6	14	13	27	(8)
2032	0	13	13	6	15	13	28	(9)
2033	0	13	13	6	16	14	30	(10)
2034	0	13	13	6	16	15	31	(11)
2035	0	13	13	6	17	15	32	(12)
2036	0	13	13	6	18	16	33	(14)
2037	0	13	13	6	18	16	35	(15)
2038	0	13	13	6	19	17	36	(16)
2039	0	13	13	6	20	17	37	(17)
2040	0	13	13	6	21	18	38	(19)

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 10 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[17] The study estimated 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it was determined the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	12	14	10	3	4	6	17
2017	1	12	14	10	3	4	7	16
2018	1	12	13	10	3	5	8	15
2019	1	13	13	10	4	6	10	13
2020	0	13	13	10	5	7	11	11
2021	0	13	13	10	6	7	13	9
2022	0	13	13	10	7	8	14	8
2023	0	13	13	10	7	8	16	7
2024	0	13	13	10	8	9	17	5
2025	0	13	13	10	9	9	19	4
2026	0	13	13	10	10	10	20	2
2027	0	13	13	10	11	11	21	1
2028	0	13	13	10	12	11	23	(0)
2029	0	13	13	10	13	12	24	(2)
2030	0	13	13	10	13	12	26	(3)
2031	0	13	13	10	14	13	27	(4)
2032	0	13	13	10	15	13	28	(6)
2033	0	13	13	10	16	14	30	(7)
2034	0	13	13	10	16	15	31	(8)
2035	0	13	13	10	17	15	32	(9)
2036	0	13	13	10	18	16	33	(10)
2037	0	13	13	10	18	16	35	(12)
2038	0	13	13	10	19	17	36	(13)
2039	0	13	13	10	20	17	37	(14)
2040	0	13	13	10	21	18	38	(15)

4. Rain Barrels
   a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Conroe Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Conroe's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Conroe's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in Conroe's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

---

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Conroe with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	505	210	715	16	0	16	699
2016	519	213	733	20	0	20	712
2017	527	217	744	20	0	20	724
2018	536	220	756	25	0	25	732
2019	545	224	769	29	0	29	740
2020	554	228	781	37	0	37	744
2021	563	232	795	44	0	44	752
2022	572	237	809	50	0	50	759
2023	582	241	823	57	0	57	766
2024	592	246	838	64	0	64	774
2025	602	250	852	71	0	71	781
2026	611	255	866	77	0	77	789
2027	622	259	882	84	0	84	797
2028	632	264	896	91	0	91	805
2029	642	269	910	98	0	98	812
2030	651	273	924	105	0	105	820
2031	659	277	937	110	0	110	826
2032	668	281	950	116	0	116	833
2033	677	285	963	122	0	122	841
2034	686	289	976	128	0	128	848
2035	695	293	989	134	0	134	855
2036	704	297	1,002	139	0	139	862
2037	713	302	1,015	145	0	145	870
2038	722	306	1,028	151	0	151	877
2039	731	310	1,041	157	0	157	884
2040	740	314	1,054	163	0	163	891
2041	749	318	1,066	173	0	173	893
2042	757	321	1,078	184	0	184	895
2043	765	325	1,090	194	0	194	896
2044	773	329	1,102	205	0	205	897
2045	782	333	1,114	215	0	215	899
2046	790	336	1,127	226	0	226	901
2047	799	340	1,139	236	0	236	903
2048	807	344	1,151	247	0	247	905
2049	816	348	1,163	257	0	257	906
2050	824	351	1,176	268	0	268	908
2051	834	355	1,189	271	0	271	919
2052	843	359	1,202	273	0	273	929
2053	852	363	1,216	276	0	276	939
2054	861	367	1,228	279	0	279	949
2055	870	371	1,241	282	0	282	959
2056	879	375	1,255	285	0	285	969
2057	888	379	1,268	288	0	288	980
2058	898	383	1,281	291	0	291	990
2059	907	388	1,295	294	0	294	1,000
2060	916	392	1,308	297	0	297	1,011
2061	926	396	1,322	299	0	299	1,023
2062	936	400	1,336	302	0	302	1,035
2063	946	404	1,351	304	0	304	1,047
2064	956	409	1,365	306	0	306	1,059
2065	966	413	1,379	308	0	308	1,071
2066	977	417	1,394	311	0	311	1,084
2067	987	422	1,409	313	0	313	1,096
2068	997	426	1,423	315	0	315	1,108
2069	1,007	430	1,437	317	0	317	1,120
2070	1,017	435	1,451	320	0	320	1,132

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Conroe's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	160	0	0	0
1	2016	73,088	159	21	733	711
2	2017	74,298	158	43	744	701
3	2018	75,507	158	66	756	690
4	2019	76,717	157	90	769	679
5-year Goal	2020	77,926	156	114	781	667
6	2021	79,485	155	139	795	656
7	2022	81,044	154	166	809	643
8	2023	82,603	154	193	823	630
9	2024	84,162	153	221	838	616
10-year Goal	2025	85,721	152	250	852	602

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Conroe's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2016	73,088	16.80	5	213	208
2	2017	74,298	16.60	11	217	206
3	2018	75,507	16.40	17	220	204
4	2019	76,717	16.20	22	224	202
5-year Goal	2020	77,926	16.00	28	228	199
6	2021	79,485	15.80	35	232	197
7	2022	81,044	15.60	41	237	195
8	2023	82,603	15.40	48	241	193
9	2024	84,162	15.20	55	246	190
10-year Goal	2025	85,721	15.00	63	250	188

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
    a. Savings of 210 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[16]
        i. 4.0% increase in 2014
        ii. 2.0% increase in 2015
        iii. .6% increase in 2016
    b. Estimated customer demand reduction of 1.3%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; TWDB, 2013)

---

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

7. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 4.0% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

8. **Kitchen Pre-rinse Spray Valves (ICI)**
    a. 106 replaced valves in 2010
    b. Estimated savings of 28,280 gallons per year per valve (CUWCC, 2004; SWB, 2007)
    c. 10-year useful life assumed

9. **Rain Barrels**
    a. In Region H, estimated savings of 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels and systems

[18] The study estimates 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, the study can determine the savings for lower or higher percentage increases.

10. Outdoor Landscape Evaluations (SF)

a. 1,178 outdoor evaluations performed since 2011
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
    i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increases	Rain Barrels	2x Watering Ordinance	Pre-rinse Spray Valves (ICI)	W.I.S.E. Guys Landscape Evaluations (SF)	TOTAL SAVINGS
2009							0
2010	89				3		92
2011	91				3	1.6	96
2012	93		0.4	330	3	2.8	429
2013	95		0.4	336	3	3.4	438
2014	97	31	0.4	343	3	4.0	479
2015	99	48	0.4	350	3	4.9	505
2016	101	53	0.4	357	3	4.9	519
2017	103	54	0.4	364	3	3.3	527
2018	105	55	0.4	371	3	2.0	536
2019	107	56	0.4	377	3	1.0	545
2020	109	57	0.4	384	3	0.3	554
2021	111	58	0.4	391	3		563
2022	113	59		398	3		572
2023	114	60		405	3		582
2024	116	61		412	3		592
2025	118	62		418	3		602
2026	120	63		425	3		611
2027	122	65		432	3		622
2028	124	66		439	3		632
2029	126	67		446	3		642
2030	128	68		452	3		651
2031	130	68		459	3		659
2032	131	69		465	3		668
2033	133	70		471	3		677
2034	135	71		477	3		686
2035	137	72		484	3		695
2036	139	73		490	3		704
2037	140	74		496	3		713
2038	142	75		502	3		722
2039	144	76		508	3		731
2040	146	77		515	3		740
2041	147	78		520	3		749
2042	149	79		526	3		757
2043	151	79		532	3		765
2044	152	80		538	3		773
2045	154	81		544	3		782
2046	155	82		550	3		790
2047	157	83		556	3		799
2048	159	84		562	3		807
2049	160	85		567	3		816
2050	162	86		573	3		824
2051	164	87		580	3		834
2052	166	88		586	3		843
2053	168	89		593	3		852
2054	169	89		599	3		861
2055	171	90		606	3		870
2056	173	91		612	3		879
2057	175	92		619	3		888
2058	177	93		625	3		898
2059	179	94		631	3		907
2060	180	95		638	3		916
2061	182	96		645	3		926
2062	184	97		652	3		936
2063	186	98		659	3		946
2064	188	99		666	3		956
2065	190	100		673	3		966
2066	192	102		680	3		977
2067	194	103		687	3		987
2068	196	104		694	3		997
2069	198	105		701	3		1,007
2070	200	106		708	3		1,017

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	71,879	9.00	210
2016	73,088	9.00	213
2017	74,298	9.00	217
2018	75,507	9.00	220
2019	76,717	9.00	224
2020	77,926	9.00	228
2021	79,485	9.00	232
2022	81,044	9.00	237
2023	82,603	9.00	241
2024	84,162	9.00	246

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[19]
g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	519	213	733	54	20	0	20	766
2017	527	217	744	55	20	0	20	779
2018	536	220	756	56	25	0	25	788
2019	545	224	769	57	29	0	29	797
2020	554	228	781	58	37	0	37	803
2021	563	232	795	59	44	0	44	811
2022	572	237	809	60	50	0	50	819
2023	582	241	823	61	57	0	57	828
2024	592	246	838	62	64	0	64	836
2025	602	250	852	63	71	0	71	845
2026	611	255	866	64	77	0	77	853
2027	622	259	882	65	84	0	84	863
2028	632	264	896	67	91	0	91	871
2029	642	269	910	68	98	0	98	880
2030	651	273	924	69	105	0	105	888
2031	659	277	937	70	110	0	110	896
2032	668	281	950	70	116	0	116	904
2033	677	285	963	71	122	0	122	912
2034	686	289	976	72	128	0	128	920
2035	695	293	989	73	134	0	134	928
2036	704	297	1,002	74	139	0	139	937
2037	713	302	1,015	75	145	0	145	945
2038	722	306	1,028	76	151	0	151	953
2039	731	310	1,041	77	157	0	157	961
2040	740	314	1,054	78	163	0	163	969

1. Employ efforts to maintain water loss volumes near baseline level or below.
2. In the future, as your utility finds water and/or wastewater service rate increases necessary, such pricing signals should continue to be effective in reducing demand.

Statewide Water Conservation Quantification Project
City of Deer Park Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Deer Park's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Deer Park's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Deer Park's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Deer Park with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	3.0	173	176	5	10	15	160
2016	3.8	173	177	6	13	19	158
2017	3.9	174	178	6	16	22	156
2018	4.0	174	178	7	18	26	152
2019	4.0	175	179	9	21	29	149
2020	3.3	175	178	11	23	35	144
2021	2.4	176	178	13	26	39	140
2022	1.6	177	178	15	28	43	135
2023	0.8	178	178	17	30	47	131
2024	0	179	179	20	32	52	127
2025	0	179	179	22	34	56	124
2026	0	180	180	24	36	60	120
2027	0	181	181	26	39	64	117
2028	0	182	182	28	41	69	113
2029	0	183	183	30	43	73	110
2030	0	184	184	32	45	77	107
2031	0	185	185	34	47	81	103
2032	0	185	185	36	49	85	100
2033	0	186	186	38	51	89	97
2034	0	187	187	40	53	93	94
2035	0	188	188	42	55	97	90
2036	0	188	188	44	57	101	87
2037	0	189	189	46	59	105	84
2038	0	190	190	48	61	109	81
2039	0	191	191	50	63	113	77
2040	0	192	192	52	65	117	74
2041	0	192	192	54	67	121	71
2042	0	193	193	56	69	125	68
2043	0	194	194	58	71	129	65
2044	0	194	194	60	73	133	62
2045	0	195	195	62	75	137	58
2046	0	196	196	63	77	140	55
2047	0	196	196	65	79	144	52
2048	0	197	197	67	81	148	49
2049	0	198	198	69	83	152	46
2050	0	199	199	71	85	156	43
2051	0	199	199	73	87	160	40
2052	0	200	200	75	89	163	36
2053	0	200	200	77	91	167	33
2054	0	201	201	78	93	171	30
2055	0	202	202	80	95	175	27
2056	0	202	202	82	96	179	24
2057	0	203	203	84	98	182	21
2058	0	204	204	86	100	186	17
2059	0	204	204	88	102	190	14
2060	0	205	205	90	104	194	11
2061	0	206	206	91	105	197	9
2062	0	206	206	93	107	200	7
2063	0	207	207	95	108	203	4
2064	0	208	208	97	109	206	2
2065	0	208	208	98	110	209	(0)
2066	0	209	209	100	111	212	(3)
2067	0	209	209	102	113	214	(5)
2068	0	210	210	104	114	217	(7)
2069	0	211	211	105	115	220	(10)
2070	0	211	211	107	116	223	(12)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Deer Park's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	144	0	0	0
1	2015	33,806	140	47	176	129
2	2016	33,896	136	94	177	83
3	2017	33,986	133	141	178	36
4	2018	34,075	129	189	178	(11)
5-year Goal	2019	34,165	125	237	179	(58)
6	2020	34,255	124	255	178	(77)
7	2021	34,427	122	274	178	(96)
8	2022	34,599	121	293	178	(115)
9	2023	34,771	119	312	178	(134)
10-year Goal	2024	34,943	118	332	179	(153)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Deer Park's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	49.00	0	0	0
1	2015	33,806	44.20	59	173	114
2	2016	33,896	39.40	119	173	54
3	2017	33,986	34.60	179	174	(5)
4	2018	34,075	29.80	239	174	(65)
5-year Goal	2019	34,165	25.00	299	175	(125)
6	2020	34,255	23.60	318	175	(143)
7	2021	34,427	22.20	337	176	(161)
8	2022	34,599	20.80	356	177	(179)
9	2023	34,771	19.40	376	178	(198)
10-year Goal	2024	34,943	18.00	395	179	(217)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 173 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.8	0.8
2010	1.5	1.5
2011	2.3	2.3
2012	3.0	3.0
2013	3.8	3.8
2014	3.9	3.9
2015	4.0	4.0
2016	4.0	4.0
2017	3.3	3.3
2018	2.4	2.4
2019	1.6	1.6
2020	0.8	0.8
2021		0.0
2022		0.0
2023		0.0
2024		0.0
2025		0.0
2026		0.0
2027		0.0
2028		0.0
2029		0.0
2030		0.0
2031		0.0
2032		0.0
2033		0.0
2034		0.0
2035		0.0
2036		0.0
2037		0.0
2038		0.0
2039		0.0
2040		0.0
2041		0.0
2042		0.0
2043		0.0
2044		0.0
2045		0.0
2046		0.0
2047		0.0
2048		0.0
2049		0.0
2050		0.0
2051		0.0
2052		0.0
2053		0.0
2054		0.0
2055		0.0
2056		0.0
2057		0.0
2058		0.0
2059		0.0
2060		0.0
2061		0.0
2062		0.0
2063		0.0
2064		0.0
2065		0.0
2066		0.0
2067		0.0
2068		0.0
2069		0.0
2070		0.0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	49.00	0
2015	33,806	35.00	173
2016	33,896	35.00	173
2017	33,986	35.00	174
2018	34,075	35.00	174
2019	34,165	35.00	175
2020	34,255	35.00	175
2021	34,427	35.00	176
2022	34,599	35.00	177
2023	34,771	35.00	178
2024	34,943	35.00	179

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   - **a.** Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
     - i. Average Region H savings
     - ii. Specific percentage of outdoor usage unknown for your utility at this time
   - **b.** Savings could be 56 MG per year with current demand.
   - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4	173	177	56	6	13	19	213
2017	4	174	178	56	6	16	22	211
2018	4	174	178	56	7	18	26	208
2019	4	175	179	56	9	21	29	205
2020	3	175	178	56	11	23	35	200
2021	2	176	178	56	13	26	39	196
2022	2	177	178	56	15	28	43	191
2023	1	178	178	56	17	30	47	187
2024	0	179	179	56	20	32	52	183
2025	0	179	179	56	22	34	56	180
2026	0	180	180	56	24	36	60	177
2027	0	181	181	56	26	39	64	173
2028	0	182	182	57	28	41	69	170
2029	0	183	183	57	30	43	73	167
2030	0	184	184	57	32	45	77	163
2031	0	185	185	57	34	47	81	160
2032	0	185	185	57	36	49	85	157
2033	0	186	186	57	38	51	89	154
2034	0	187	187	57	40	53	93	151
2035	0	188	188	57	42	55	97	147
2036	0	188	188	57	44	57	101	144
2037	0	189	189	57	46	59	105	141
2038	0	190	190	57	48	61	109	138
2039	0	191	191	57	50	63	113	135
2040	0	192	192	57	52	65	117	132

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4	173	177	19	6	13	19	176
2017	4	174	178	19	6	16	22	174
2018	4	174	178	19	7	18	26	171
2019	4	175	179	19	9	21	29	168
2020	3	175	178	19	11	23	35	162
2021	2	176	178	19	13	26	39	158
2022	2	177	178	19	15	28	43	154
2023	1	178	178	19	17	30	47	150
2024	0	179	179	19	20	32	52	146
2025	0	179	179	19	22	34	56	142
2026	0	180	180	19	24	36	60	139
2027	0	181	181	19	26	39	64	136
2028	0	182	182	19	28	41	69	132
2029	0	183	183	19	30	43	73	129
2030	0	184	184	19	32	45	77	126
2031	0	185	185	19	34	47	81	122
2032	0	185	185	19	36	49	85	119
2033	0	186	186	19	38	51	89	116
2034	0	187	187	19	40	53	93	113
2035	0	188	188	19	42	55	97	110
2036	0	188	188	19	44	57	101	106
2037	0	189	189	19	46	59	105	103
2038	0	190	190	19	48	61	109	100
2039	0	191	191	19	50	63	113	97
2040	0	192	192	19	52	65	117	93

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 28 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4	173	177	28	6	13	19	186
2017	4	174	178	28	6	16	22	184
2018	4	174	178	28	7	18	26	180
2019	4	175	179	28	9	21	29	177
2020	3	175	178	28	11	23	35	172
2021	2	176	178	28	13	26	39	168
2022	2	177	178	28	15	28	43	163
2023	1	178	178	28	17	30	47	159
2024	0	179	179	28	20	32	52	155
2025	0	179	179	28	22	34	56	152
2026	0	180	180	28	24	36	60	148
2027	0	181	181	28	26	39	64	145
2028	0	182	182	28	28	41	69	142
2029	0	183	183	28	30	43	73	138
2030	0	184	184	28	32	45	77	135
2031	0	185	185	28	34	47	81	132
2032	0	185	185	28	36	49	85	129
2033	0	186	186	28	38	51	89	125
2034	0	187	187	28	40	53	93	122
2035	0	188	188	29	42	55	97	119
2036	0	188	188	29	44	57	101	116
2037	0	189	189	29	46	59	105	113
2038	0	190	190	29	48	61	109	109
2039	0	191	191	29	50	63	113	106
2040	0	192	192	29	52	65	117	103

4. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Friendswood Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Friendswood's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Friendswood's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Friendswood's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Friendswood with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	5.2	(84)	(79)	4	0	4	(83)
2016	5.2	(84)	(79)	5	0	5	(84)
2017	4.3	(85)	(81)	5	0	5	(86)
2018	3.2	(86)	(82)	6	0	6	(88)
2019	2.0	(86)	(84)	7	0	7	(91)
2020	1.0	(87)	(86)	9	0	9	(95)
2021	0	(88)	(88)	11	0	11	(99)
2022	0	(89)	(89)	13	0	13	(102)
2023	0	(90)	(90)	15	0	15	(105)
2024	0	(91)	(91)	17	0	17	(108)
2025	0	(92)	(92)	19	0	19	(111)
2026	0	(93)	(93)	21	0	21	(114)
2027	0	(94)	(94)	23	0	23	(117)
2028	0	(95)	(95)	25	0	25	(120)
2029	0	(96)	(96)	27	0	27	(123)
2030	0	(96)	(96)	29	0	29	(126)
2031	0	(97)	(97)	31	0	31	(129)
2032	0	(98)	(98)	34	0	34	(132)
2033	0	(99)	(99)	36	0	36	(135)
2034	0	(100)	(100)	38	0	38	(138)
2035	0	(101)	(101)	40	0	40	(140)
2036	0	(102)	(102)	42	0	42	(143)
2037	0	(102)	(102)	44	0	44	(146)
2038	0	(103)	(103)	46	0	46	(149)
2039	0	(104)	(104)	48	0	48	(152)
2040	0	(105)	(105)	50	0	50	(155)
2041	0	(106)	(106)	52	0	52	(158)
2042	0	(107)	(107)	55	0	55	(162)
2043	0	(108)	(108)	57	0	57	(165)
2044	0	(109)	(109)	59	0	59	(168)
2045	0	(109)	(109)	62	0	62	(171)
2046	0	(110)	(110)	64	0	64	(174)
2047	0	(111)	(111)	66	0	66	(177)
2048	0	(112)	(112)	68	0	68	(181)
2049	0	(113)	(113)	71	0	71	(184)
2050	0	(114)	(114)	73	0	73	(187)
2051	0	(115)	(115)	75	0	75	(190)
2052	0	(116)	(116)	78	0	78	(194)
2053	0	(117)	(117)	80	0	80	(197)
2054	0	(118)	(118)	83	0	83	(200)
2055	0	(119)	(119)	85	0	85	(204)
2056	0	(120)	(120)	87	0	87	(207)
2057	0	(121)	(121)	90	0	90	(210)
2058	0	(121)	(121)	92	0	92	(213)
2059	0	(122)	(122)	94	0	94	(217)
2060	0	(123)	(123)	97	0	97	(220)
2061	0	(124)	(124)	99	0	99	(224)
2062	0	(125)	(125)	102	0	102	(227)
2063	0	(126)	(126)	105	0	105	(231)
2064	0	(127)	(127)	107	0	107	(235)
2065	0	(129)	(129)	110	0	110	(238)
2066	0	(130)	(130)	112	0	112	(242)
2067	0	(131)	(131)	115	0	115	(246)
2068	0	(132)	(132)	118	0	118	(249)
2069	0	(133)	(133)	120	0	120	(253)
2070	0	(134)	(134)	123	0	123	(257)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Friendswood's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	136	0	0	0
1	2015	38,248	135	8	(79)	(87)
2	2016	38,528	135	17	(79)	(96)
3	2017	38,808	134	25	(81)	(106)
4	2018	39,089	134	34	(82)	(117)
5-year Goal	2019	39,369	133	43	(84)	(127)
6	2020	39,649	132	52	(86)	(138)
7	2021	40,089	132	61	(88)	(149)
8	2022	40,529	131	71	(89)	(160)
9	2023	40,969	131	81	(90)	(170)
10-year Goal	2024	41,409	130	91	(91)	(181)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Friendswood's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	38,248	15.00	0	(84)	(84)
2	2016	38,528	15.00	0	(84)	(84)
3	2017	38,808	15.00	0	(85)	(85)
4	2018	39,089	15.00	0	(86)	(86)
5-year Goal	2019	39,369	15.00	0	(86)	(86)
6	2020	39,649	15.00	0	(87)	(87)
7	2021	40,089	15.00	0	(88)	(88)
8	2022	40,529	15.00	0	(89)	(89)
9	2023	40,969	15.00	0	(90)	(90)
10-year Goal	2024	41,409	15.00	0	(91)	(91)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 84 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	1.1	1.1
2010	2.0	2.0
2011	3.0	3.0
2012	3.9	3.9
2013	5.0	5.0
2014	5.1	5.1
2015	5.2	5.2
2016	5.2	5.2
2017	4.3	4.3
2018	3.2	3.2
2019	2.0	2.0
2020	1.0	1.0
2021		0.0
2022		0.0
2023		0.0
2024		0.0
2025		0.0
2026		0.0
2027		0.0
2028		0.0
2029		0.0
2030		0.0
2031		0.0
2032		0.0
2033		0.0
2034		0.0
2035		0.0
2036		0.0
2037		0.0
2038		0.0
2039		0.0
2040		0.0
2041		0.0
2042		0.0
2043		0.0
2044		0.0
2045		0.0
2046		0.0
2047		0.0
2048		0.0
2049		0.0
2050		0.0
2051		0.0
2052		0.0
2053		0.0
2054		0.0
2055		0.0
2056		0.0
2057		0.0
2058		0.0
2059		0.0
2060		0.0
2061		0.0
2062		0.0
2063		0.0
2064		0.0
2065		0.0
2066		0.0
2067		0.0
2068		0.0
2069		0.0
2070		0.0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	38,248	21.00	(84)
2016	38,528	21.00	(84)
2017	38,808	21.00	(85)
2018	39,089	21.00	(86)
2019	39,369	21.00	(86)
2020	39,649	21.00	(87)
2021	40,089	21.00	(88)
2022	40,529	21.00	(89)
2023	40,969	21.00	(90)
2024	41,409	21.00	(91)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 10.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    b. Savings could be 222 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	(84)	(79)	222	5	0	5	138
2017	4	(85)	(81)	224	5	0	5	138
2018	3	(86)	(82)	226	6	0	6	138
2019	2	(86)	(84)	228	7	0	7	137
2020	1	(87)	(86)	230	9	0	9	135
2021	0	(88)	(88)	232	11	0	11	133
2022	0	(89)	(89)	234	13	0	13	132
2023	0	(90)	(90)	236	15	0	15	131
2024	0	(91)	(91)	238	17	0	17	130
2025	0	(92)	(92)	240	19	0	19	129
2026	0	(93)	(93)	242	21	0	21	128
2027	0	(94)	(94)	244	23	0	23	127
2028	0	(95)	(95)	246	25	0	25	126
2029	0	(96)	(96)	248	27	0	27	125
2030	0	(96)	(96)	250	29	0	29	124
2031	0	(97)	(97)	252	31	0	31	123
2032	0	(98)	(98)	253	34	0	34	122
2033	0	(99)	(99)	255	36	0	36	121
2034	0	(100)	(100)	257	38	0	38	119
2035	0	(101)	(101)	259	40	0	40	118
2036	0	(102)	(102)	260	42	0	42	117
2037	0	(102)	(102)	262	44	0	44	116
2038	0	(103)	(103)	264	46	0	46	115
2039	0	(104)	(104)	266	48	0	48	114
2040	0	(105)	(105)	268	50	0	50	112

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	(84)	(79)	29	5	0	5	(55)
2017	4	(85)	(81)	30	5	0	5	(56)
2018	3	(86)	(82)	30	6	0	6	(59)
2019	2	(86)	(84)	30	7	0	7	(61)
2020	1	(87)	(86)	30	9	0	9	(64)
2021	0	(88)	(88)	31	11	0	11	(68)
2022	0	(89)	(89)	31	13	0	13	(71)
2023	0	(90)	(90)	31	15	0	15	(74)
2024	0	(91)	(91)	32	17	0	17	(76)
2025	0	(92)	(92)	32	19	0	19	(79)
2026	0	(93)	(93)	32	21	0	21	(82)
2027	0	(94)	(94)	32	23	0	23	(85)
2028	0	(95)	(95)	33	25	0	25	(87)
2029	0	(96)	(96)	33	27	0	27	(90)
2030	0	(96)	(96)	33	29	0	29	(93)
2031	0	(97)	(97)	33	31	0	31	(95)
2032	0	(98)	(98)	34	34	0	34	(98)
2033	0	(99)	(99)	34	36	0	36	(101)
2034	0	(100)	(100)	34	38	0	38	(103)
2035	0	(101)	(101)	34	40	0	40	(106)
2036	0	(102)	(102)	35	42	0	42	(109)
2037	0	(102)	(102)	35	44	0	44	(112)
2038	0	(103)	(103)	35	46	0	46	(114)
2039	0	(104)	(104)	35	48	0	48	(117)
2040	0	(105)	(105)	35	50	0	50	(120)

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 44 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	(84)	(79)	44	5	0	5	(40)
2017	4	(85)	(81)	44	5	0	5	(41)
2018	3	(86)	(82)	45	6	0	6	(44)
2019	2	(86)	(84)	45	7	0	7	(46)
2020	1	(87)	(86)	46	9	0	9	(49)
2021	0	(88)	(88)	46	11	0	11	(53)
2022	0	(89)	(89)	46	13	0	13	(56)
2023	0	(90)	(90)	47	15	0	15	(58)
2024	0	(91)	(91)	47	17	0	17	(61)
2025	0	(92)	(92)	47	19	0	19	(63)
2026	0	(93)	(93)	48	21	0	21	(66)
2027	0	(94)	(94)	48	23	0	23	(69)
2028	0	(95)	(95)	49	25	0	25	(71)
2029	0	(96)	(96)	49	27	0	27	(74)
2030	0	(96)	(96)	49	29	0	29	(76)
2031	0	(97)	(97)	50	31	0	31	(79)
2032	0	(98)	(98)	50	34	0	34	(82)
2033	0	(99)	(99)	50	36	0	36	(84)
2034	0	(100)	(100)	51	38	0	38	(87)
2035	0	(101)	(101)	51	40	0	40	(89)
2036	0	(102)	(102)	52	42	0	42	(92)
2037	0	(102)	(102)	52	44	0	44	(94)
2038	0	(103)	(103)	52	46	0	46	(97)
2039	0	(104)	(104)	53	48	0	48	(100)
2040	0	(105)	(105)	53	50	0	50	(102)

4. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Galveston Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Galveston's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Galveston's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Galveston's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Galveston with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	247	0	247	5	31	36	211
2016	248	0	248	7	39	45	203
2017	248	0	248	7	46	53	195
2018	248	0	248	8	54	62	186
2019	248	0	248	9	62	71	177
2020	248	0	248	12	69	81	166
2021	248	0	248	14	76	91	157
2022	249	0	249	17	83	100	149
2023	250	0	250	19	90	109	141
2024	251	0	251	22	97	119	132
2025	252	0	252	24	104	128	124
2026	254	0	254	26	111	137	116
2027	255	0	255	29	118	147	108
2028	256	0	256	31	125	156	100
2029	257	0	257	33	132	165	92
2030	258	0	258	36	139	175	84
2031	260	0	260	38	145	184	76
2032	261	0	261	41	152	193	68
2033	262	0	262	43	158	202	60
2034	263	0	263	46	165	211	53
2035	265	0	265	49	171	220	45
2036	266	0	266	51	178	229	37
2037	267	0	267	54	184	238	29
2038	269	0	269	56	191	247	21
2039	270	0	270	59	197	256	14
2040	271	0	271	61	204	265	6
2041	273	0	273	64	205	269	4
2042	274	0	274	66	206	272	2
2043	275	0	275	69	207	276	(0)
2044	277	0	277	71	208	279	(3)
2045	278	0	278	73	209	283	(5)
2046	280	0	280	76	210	286	(7)
2047	281	0	281	78	212	290	(9)
2048	283	0	283	81	213	293	(11)
2049	284	0	284	83	214	297	(13)
2050	285	0	285	86	215	300	(15)
2051	287	0	287	88	216	304	(17)
2052	288	0	288	91	217	307	(19)
2053	289	0	289	93	218	311	(21)
2054	291	0	291	96	219	314	(24)
2055	292	0	292	98	220	318	(26)
2056	294	0	294	101	221	321	(28)
2057	295	0	295	103	222	325	(30)
2058	296	0	296	106	223	328	(32)
2059	298	0	298	108	224	332	(34)
2060	299	0	299	110	225	335	(36)
2061	300	0	300	113	226	339	(39)
2062	302	0	302	116	227	343	(41)
2063	303	0	303	118	228	347	(43)
2064	305	0	305	121	229	350	(45)
2065	306	0	306	124	230	354	(48)
2066	308	0	308	126	232	358	(50)
2067	309	0	309	129	233	362	(52)
2068	311	0	311	132	234	365	(55)
2069	312	0	312	134	235	369	(57)
2070	314	0	314	137	236	373	(59)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Galveston's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	267	0	0	0
1	2015	48,950	266	11	247	237
2	2016	49,412	266	22	248	227
3	2017	49,874	265	33	248	216
4	2018	50,336	265	44	248	204
5-year Goal	2019	50,798	264	56	248	192
6	2,020	51,260	263	75	248	173
7	2,021	51,598	262	94	248	154
8	2,022	51,937	261	114	249	135
9	2,023	52,275	260	134	250	116
10-year Goal	2,024	52,613	259	154	251	98

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Galveston's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	26.00	0	0	0
1	2015	48,950	26.00	0	0	0
2	2016	49,412	26.00	0	0	0
3	2017	49,874	26.00	0	0	0
4	2018	50,336	26.00	0	0	0
5-year Goal	2019	50,798	26.00	0	0	0
6	2,020	51,260	26	4	0	(4)
7	2,021	51,598	26	8	0	(8)
8	2,022	51,937	25	11	0	(11)
9	2,023	52,275	25	15	0	(15)
10-year Goal	2,024	52,613	25	19	0	(19)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 22.78% increase in 2015
    b. Estimated customer demand reduction of 4.55%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	WaterWise Take-home Kits	TOTAL SAVINGS
2009		1.4	1.4
2010		2.6	2.6
2011		3.9	3.9
2012		5.1	5.1
2013		6.5	6.5
2014		6.6	6.6
2015	241	6.7	247.3
2016	242	6.7	248.5
2017	243	5.5	248.4
2018	244	4.1	248.2
2019	245	2.6	248.0
2020	246	1.3	247.8
2021	248		247.7
2022	249		248.9
2023	250		250.0
2024	251		251.2
2025	252		252.4
2026	254		253.6
2027	255		254.8
2028	256		256.0
2029	257		257.2
2030	258		258.3
2031	260		259.6
2032	261		260.9
2033	262		262.2
2034	263		263.5
2035	265		264.7
2036	266		266.0
2037	267		267.3
2038	269		268.6
2039	270		269.9
2040	271		271.1
2041	273		272.6
2042	274		274.0
2043	275		275.4
2044	277		276.8
2045	278		278.2
2046	280		279.7
2047	281		281.1
2048	283		282.5
2049	284		283.9
2050	285		285.4
2051	287		286.7
2052	288		288.1
2053	289		289.5
2054	291		290.8
2055	292		292.2
2056	294		293.6
2057	295		294.9
2058	296		296.3
2059	298		297.6
2060	299		299.0
2061	300		300.5
2062	302		301.9
2063	303		303.4
2064	305		304.9
2065	306		306.3
2066	308		307.8
2067	309		309.3
2068	311		310.7
2069	312		312.2
2070	314		313.7

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	26.00	0
2015	48,277	26.00	0
2016	48,501	26.00	0
2017	48,726	26.00	0
2018	48,950	26.00	0
2019	49,412	26.00	0
2020	49,874	26.00	0
2021	50,336	26.00	0
2022	50,798	26.00	0
2023	51,260	26.00	0
2024	51,598	26.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 213 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	248	0	248	213	7	39	45	416
2017	248	0	248	214	7	46	53	409
2018	248	0	248	215	8	54	62	401
2019	248	0	248	216	9	62	71	393
2020	248	0	248	217	12	69	81	383
2021	248	0	248	218	14	76	91	375
2022	249	0	249	219	17	83	100	368
2023	250	0	250	220	19	90	109	360
2024	251	0	251	221	22	97	119	353
2025	252	0	252	222	24	104	128	346
2026	254	0	254	223	26	111	137	339
2027	255	0	255	224	29	118	147	332
2028	256	0	256	225	31	125	156	325
2029	257	0	257	226	33	132	165	318
2030	258	0	258	227	36	139	175	311
2031	260	0	260	228	38	145	184	304
2032	261	0	261	229	41	152	193	297
2033	262	0	262	230	43	158	202	291
2034	263	0	263	232	46	165	211	284
2035	265	0	265	233	49	171	220	277
2036	266	0	266	234	51	178	229	271
2037	267	0	267	235	54	184	238	264
2038	269	0	269	236	56	191	247	258
2039	270	0	270	237	59	197	256	251
2040	271	0	271	238	61	204	265	244

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	248	0	248	71	7	39	45	274
2017	248	0	248	72	7	46	53	267
2018	248	0	248	72	8	54	62	258
2019	248	0	248	72	9	62	71	249
2020	248	0	248	73	12	69	81	239
2021	248	0	248	73	14	76	91	230
2022	249	0	249	73	17	83	100	222
2023	250	0	250	74	19	90	109	214
2024	251	0	251	74	22	97	119	206
2025	252	0	252	74	24	104	128	199
2026	254	0	254	75	26	111	137	191
2027	255	0	255	75	29	118	147	183
2028	256	0	256	75	31	125	156	175
2029	257	0	257	76	33	132	165	168
2030	258	0	258	76	36	139	175	160
2031	260	0	260	76	38	145	184	152
2032	261	0	261	77	41	152	193	145
2033	262	0	262	77	43	158	202	138
2034	263	0	263	78	46	165	211	130
2035	265	0	265	78	49	171	220	123
2036	266	0	266	78	51	178	229	115
2037	267	0	267	79	54	184	238	108
2038	269	0	269	79	56	191	247	101
2039	270	0	270	79	59	197	256	93
2040	271	0	271	80	61	204	265	86

3. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Houston Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Houston's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Houston's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Houston's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Houston with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	2,058	3,937	5,995	525	950	1,475	4,520
2016	2,070	3,987	6,057	656	1,187	1,843	4,213
2017	3,025	4,037	7,062	656	1,425	2,081	4,981
2018	2,988	4,087	7,075	787	1,662	2,449	4,625
2019	2,946	4,090	7,037	918	1,900	2,818	4,219
2020	2,911	4,094	7,005	1,181	2,137	3,318	3,687
2021	2,876	4,097	6,973	1,418	2,354	3,772	3,201
2022	2,892	4,100	6,992	1,656	2,570	4,226	2,766
2023	2,908	4,103	7,011	1,893	2,787	4,680	2,331
2024	2,924	4,136	7,060	2,131	3,003	5,135	1,925
2025	2,939	4,169	7,108	2,369	3,220	5,589	1,519
2026	2,954	4,202	7,157	2,606	3,437	6,043	1,114
2027	2,970	4,235	7,205	2,844	3,653	6,497	708
2028	2,986	4,268	7,254	3,081	3,870	6,951	303
2029	3,002	4,301	7,303	3,319	4,086	7,405	(102)
2030	3,019	4,334	7,352	3,557	4,303	7,859	(507)
2031	3,035	4,367	7,402	3,798	4,522	8,320	(918)
2032	3,052	4,399	7,452	4,039	4,742	8,780	(1,329)
2033	3,069	4,432	7,502	4,280	4,961	9,241	(1,739)
2034	3,086	4,465	7,551	4,521	5,180	9,701	(2,150)
2035	3,103	4,497	7,600	4,762	5,400	10,162	(2,562)
2036	3,120	4,529	7,649	5,003	5,619	10,622	(2,973)
2037	3,137	4,562	7,698	5,244	5,838	11,083	(3,384)
2038	3,153	4,594	7,748	5,485	6,058	11,543	(3,795)
2039	3,170	4,627	7,797	5,726	6,277	12,004	(4,207)
2040	3,187	4,659	7,846	5,968	6,496	12,464	(4,618)
2041	3,206	4,691	7,897	6,214	6,722	12,936	(5,038)
2042	3,225	4,724	7,949	6,460	6,948	13,408	(5,459)
2043	3,244	4,756	8,000	6,706	7,173	13,879	(5,880)
2044	3,262	4,788	8,051	6,952	7,399	14,351	(6,300)
2045	3,281	4,821	8,102	7,198	7,624	14,823	(6,721)
2046	3,300	4,853	8,153	7,444	7,850	15,294	(7,141)
2047	3,319	4,886	8,205	7,691	8,076	15,766	(7,562)
2048	3,338	4,918	8,256	7,937	8,301	16,238	(7,982)
2049	3,356	4,951	8,307	8,183	8,527	16,710	(8,403)
2050	3,375	4,983	8,358	8,429	8,752	17,181	(8,823)
2051	3,397	5,015	8,412	8,680	8,822	17,502	(9,090)
2052	3,418	5,048	8,466	8,932	8,891	17,823	(9,358)
2053	3,439	5,080	8,519	9,183	8,961	18,144	(9,625)
2054	3,460	5,113	8,574	9,435	9,030	18,465	(9,891)
2055	3,482	5,147	8,628	9,686	9,100	18,786	(10,158)
2056	3,503	5,180	8,683	9,937	9,169	19,107	(10,424)
2057	3,524	5,213	8,737	10,189	9,239	19,428	(10,690)
2058	3,546	5,246	8,792	10,440	9,308	19,748	(10,957)
2059	3,567	5,279	8,846	10,692	9,378	20,069	(11,223)
2060	3,588	5,313	8,901	10,943	9,447	20,390	(11,489)
2061	3,611	5,346	8,957	11,200	9,507	20,707	(11,751)
2062	3,633	5,379	9,012	11,458	9,567	21,025	(12,012)
2063	3,656	5,412	9,068	11,715	9,627	21,342	(12,273)
2064	3,679	5,447	9,125	11,972	9,687	21,659	(12,533)
2065	3,701	5,481	9,182	12,229	9,747	21,976	(12,793)
2066	3,724	5,516	9,240	12,487	9,806	22,293	(13,053)
2067	3,746	5,550	9,297	12,744	9,866	22,610	(13,313)
2068	3,769	5,585	9,354	13,001	9,926	22,927	(13,573)
2069	3,792	5,619	9,411	13,258	9,986	23,244	(13,833)
2070	3,814	5,654	9,468	13,516	10,046	23,562	(14,093)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Houston's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	152	0	0	0
1	2015	2,239,558	152	327	5,995	5,668
2	2016	2,241,329	151	654	6,057	5,402
3	2017	2,243,100	151	982	7,062	6,079
4	2018	2,244,872	150	1,311	7,075	5,764
5-year Goal	2019	2,246,643	150	1,640	7,037	5,397
6	2020	2,248,414	150	2,035	7,005	4,970
7	2021	2,266,441	149	2,449	6,973	4,524
8	2022	2,284,467	149	2,868	6,992	4,124
9	2023	2,302,494	148	3,294	7,011	3,717
10-year Goal	2024	2,320,520	148	3,727	7,060	3,333

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Houston's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	31.00	0	0	0
1	2015	2,239,558	30.88	98	3,937	3,838
2	2016	2,241,329	30.76	196	3,987	3,790
3	2017	2,243,100	30.64	295	4,037	3,742
4	2018	2,244,872	30.52	393	4,087	3,694
5-year Goal	2019	2,246,643	30.40	492	4,090	3,598
6	2020	2,248,414	30.28	591	4,094	3,503
7	2021	2,266,441	30.16	695	4,097	3,402
8	2022	2,284,467	30.04	800	4,100	3,300
9	2023	2,302,494	29.92	908	4,103	3,196
10-year Goal	2024	2,320,520	29.80	1,016	4,136	3,120

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 3,937 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 3.4% increase in 2016
    b. Estimated customer demand reduction of .68%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years

5. **Advanced Metering Infrastructure (AMI) with Customer Engagement Portal**
    a. Houston uses a proprietary portal in its Consumption Awareness Program (CAP).
    b. Implemented in 2014
    c. Estimated savings of 1,784 MG in 2016
        i. Specific utility results may vary based on portal features and notifications
    d. Savings estimate assumes 20% of residential customers are using[19] and saving water due to the portal (Westin Engineering, 2015)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

e. Assumes customers save 10% of total annual use due to the portal
    i. Savings estimate is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
f. Residential customers' use makes up approximately 61% of all retail customers' use based on utility profile information submitted to the TWDB
g. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.23% of total demand
h. Savings are assumed to increase along with demand as connections increase each year[20]

6. **Rain Barrels**
    a. In Region H, estimated savings of 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. 1,819 50-gallon barrels sold since 2014
    c. Estimated 10-year useful life for most barrels

7. **WaterWise Take-home Kits**
    a. Estimated 46,471 kits distributed annually in Houston service area
        i. Pro-rata share of all kits distributed in Harris County by program implemented by Harris-Galveston Subsidence District and Resource Action Programs
    b. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    c. Conservative 5-year useful life for all items in kit
    d. 15% adoption rate assumed

8. **Save Water Co. Commercial, Multi-family and Hotel Programs[21]**
    a. Project initiated in service area in 2014
    b. Save Water completed work on 927 multi-family units by 2015
    c. Average monthly savings of 305,190 gallons
    d. Total annualized savings of 21.97 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
        i. The company’s work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

---

[19] Attempts to garner more precise participation figures for the Consumption Awareness Program (CAP) from staff were unsuccessful.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

[21] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	AMI with Customer Portal	Rain Barrels	WaterWise Take-home Kits	Save Water Co. Program	TOTAL SAVINGS
2009				53.4		53
2010				99.5		99
2011				150.3		150
2012				198.0		198
2013				251.5		252
2014		1,763	0.6	255.5	11	2,031
2015		1,774	1.7	260.9	22	2,058
2016		1,784	2.0	261.5	22	2,070
2017	992	1,795	2.4	213.8	22	3,025
2018	998	1,805	2.4	160.3	22	2,988
2019	1,004	1,815	2.4	102.9	22	2,946
2020	1,009	1,826	2.4	51.5	22	2,911
2021	1,015	1,836	2.4		22	2,876
2022	1,021	1,847	2.4		22	2,892
2023	1,027	1,857	2.4		22	2,908
2024	1,032	1,867	1.9		22	2,924
2025	1,038	1,878	0.7		22	2,939
2026	1,044	1,888	0.4		22	2,954
2027	1,050	1,899			22	2,970
2028	1,055	1,909			22	2,986
2029	1,061	1,919			22	3,002
2030	1,067	1,930			22	3,019
2031	1,073	1,941			22	3,035
2032	1,079	1,951			22	3,052
2033	1,085	1,962			22	3,069
2034	1,091	1,973			22	3,086
2035	1,097	1,984			22	3,103
2036	1,103	1,995			22	3,120
2037	1,109	2,006			22	3,137
2038	1,115	2,017			22	3,153
2039	1,121	2,027			22	3,170
2040	1,127	2,038			22	3,187
2041	1,134	2,050			22	3,206
2042	1,140	2,063			22	3,225
2043	1,147	2,075			22	3,244
2044	1,154	2,087			22	3,262
2045	1,160	2,099			22	3,281
2046	1,167	2,111			22	3,300
2047	1,174	2,123			22	3,319
2048	1,180	2,135			22	3,338
2049	1,187	2,147			22	3,356
2050	1,194	2,159			22	3,375
2051	1,201	2,173			22	3,397
2052	1,209	2,187			22	3,418
2053	1,217	2,201			22	3,439
2054	1,224	2,214			22	3,460
2055	1,232	2,228			22	3,482
2056	1,239	2,242			22	3,503
2057	1,247	2,255			22	3,524
2058	1,254	2,269			22	3,546
2059	1,262	2,283			22	3,567
2060	1,270	2,297			22	3,588
2061	1,278	2,311			22	3,611
2062	1,286	2,326			22	3,633
2063	1,294	2,340			22	3,656
2064	1,302	2,355			22	3,679
2065	1,310	2,369			22	3,701
2066	1,318	2,384			22	3,724
2067	1,326	2,398			22	3,746
2068	1,334	2,413			22	3,769
2069	1,342	2,428			22	3,792
2070	1,350	2,442			22	3,814

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	31.00	0
2015	2,157,023	26.00	3,937
2016	2,184,535	26.00	3,987
2017	2,212,046	26.00	4,037
2018	2,239,558	26.00	4,087
2019	2,241,329	26.00	4,090
2020	2,243,100	26.00	4,094
2021	2,244,872	26.00	4,097
2022	2,246,643	26.00	4,100
2023	2,248,414	26.00	4,103
2024	2,266,441	26.00	4,136

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 3.79% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 5,498 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2,070	3,987	6,057	5,498	656	1,187	1,843	9,711
2017	3,025	4,037	7,062	5,530	656	1,425	2,081	10,511
2018	2,988	4,087	7,075	5,562	787	1,662	2,449	10,187
2019	2,946	4,090	7,037	5,594	918	1,900	2,818	9,813
2020	2,911	4,094	7,005	5,626	1,181	2,137	3,318	9,313
2021	2,876	4,097	6,973	5,658	1,418	2,354	3,772	8,858
2022	2,892	4,100	6,992	5,690	1,656	2,570	4,226	8,456
2023	2,908	4,103	7,011	5,722	1,893	2,787	4,680	8,053
2024	2,924	4,136	7,060	5,754	2,131	3,003	5,135	7,679
2025	2,939	4,169	7,108	5,786	2,369	3,220	5,589	7,305
2026	2,954	4,202	7,157	5,818	2,606	3,437	6,043	6,932
2027	2,970	4,235	7,205	5,850	2,844	3,653	6,497	6,558
2028	2,986	4,268	7,254	5,882	3,081	3,870	6,951	6,185
2029	3,002	4,301	7,303	5,914	3,319	4,086	7,405	5,812
2030	3,019	4,334	7,352	5,946	3,557	4,303	7,859	5,439
2031	3,035	4,367	7,402	5,980	3,798	4,522	8,320	5,062
2032	3,052	4,399	7,452	6,013	4,039	4,742	8,780	4,685
2033	3,069	4,432	7,502	6,047	4,280	4,961	9,241	4,307
2034	3,086	4,465	7,551	6,080	4,521	5,180	9,701	3,930
2035	3,103	4,497	7,600	6,113	4,762	5,400	10,162	3,552
2036	3,120	4,529	7,649	6,147	5,003	5,619	10,622	3,174
2037	3,137	4,562	7,698	6,180	5,244	5,838	11,083	2,796
2038	3,153	4,594	7,748	6,214	5,485	6,058	11,543	2,418
2039	3,170	4,627	7,797	6,247	5,726	6,277	12,004	2,041
2040	3,187	4,659	7,846	6,281	5,968	6,496	12,464	1,663

Statewide Water Conservation Quantification Project
City of Humble Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Humble's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Humble's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Humble's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Humble with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	2.0	28	30	3	8	11	19
2016	2.0	29	31	4	10	14	17
2017	1.6	29	31	4	12	16	15
2018	1.2	30	31	5	14	19	12
2019	0.8	30	31	6	16	22	9
2020	0.4	30	31	7	18	25	6
2021	0	31	31	9	20	29	2
2022	0	31	31	10	22	33	(2)
2023	0	31	31	12	25	37	(5)
2024	0	32	32	14	27	41	(8)
2025	0	33	33	15	29	44	(12)
2026	0	33	33	17	31	48	(15)
2027	0	34	34	19	34	52	(18)
2028	0	35	35	20	36	56	(21)
2029	0	36	36	22	38	60	(24)
2030	0	36	36	23	40	64	(28)
2031	0	37	37	25	43	68	(31)
2032	0	38	38	27	45	72	(35)
2033	0	38	38	29	47	76	(38)
2034	0	39	39	31	50	80	(42)
2035	0	39	39	32	52	84	(45)
2036	0	40	40	34	54	89	(49)
2037	0	40	40	36	57	93	(52)
2038	0	41	41	38	59	97	(56)
2039	0	41	41	40	61	101	(60)
2040	0	42	42	41	64	105	(63)
2041	0	42	42	43	66	109	(67)
2042	0	43	43	45	68	113	(71)
2043	0	43	43	47	71	117	(74)
2044	0	43	43	49	73	121	(78)
2045	0	44	44	50	75	126	(82)
2046	0	44	44	52	78	130	(86)
2047	0	45	45	54	80	134	(89)
2048	0	45	45	56	82	138	(93)
2049	0	45	45	58	85	142	(97)
2050	0	46	46	59	87	146	(101)
2051	0	46	46	61	89	150	(104)
2052	0	46	46	63	92	154	(108)
2053	0	47	47	64	94	158	(112)
2054	0	47	47	66	96	162	(115)
2055	0	47	47	68	98	166	(119)
2056	0	48	48	70	101	170	(123)
2057	0	48	48	71	103	174	(126)
2058	0	48	48	73	105	178	(130)
2059	0	48	48	75	107	182	(134)
2060	0	49	49	77	110	186	(137)
2061	0	49	49	78	112	190	(141)
2062	0	49	49	80	114	194	(144)
2063	0	49	49	81	116	197	(148)
2064	0	50	50	83	118	201	(151)
2065	0	50	50	85	120	205	(155)
2066	0	50	50	86	122	208	(158)
2067	0	50	50	88	124	212	(162)
2068	0	50	50	89	126	216	(165)
2069	0	51	51	91	129	220	(169)
2070	0	51	51	93	131	223	(172)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Humble's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	193	0	0	0
1	2015	16,195	191	12	30	19
2	2016	16,405	189	24	31	7
3	2017	16,614	187	36	31	(6)
4	2018	16,824	185	49	31	(18)
5-year Goal	2019	17,033	183	62	31	(31)
6	2020	17,243	182	69	31	(39)
7	2021	17,612	181	77	31	(46)
8	2022	17,980	180	85	31	(54)
9	2023	18,349	179	94	31	(62)
10-year Goal	2024	18,717	178	102	32	(70)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Humble's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	19.00	0	0	0
1	2015	16,195	19.00	0	28	28
2	2016	16,405	19.00	0	29	29
3	2017	16,614	19.00	0	29	29
4	2018	16,824	19.00	0	30	30
5-year Goal	2019	17,033	19.00	0	30	30
6	2020	17,243	18.80	1	30	29
7	2021	17,612	18.60	3	31	28
8	2022	17,980	18.40	4	31	27
9	2023	18,349	18.20	5	31	26
10-year Goal	2024	18,717	18.00	7	32	25

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 28 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.4	0.4
2010	0.8	0.8
2011	1.2	1.2
2012	1.5	1.5
2013	1.9	1.9
2014	2.0	2.0
2015	2.0	2.0
2016	2.0	2.0
2017	1.6	1.6
2018	1.2	1.2
2019	0.8	0.8
2020	0.4	0.4
2021		0
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	19.00	0
2015	15,570	14.00	28
2016	15,779	14.00	29
2017	15,987	14.00	29
2018	16,195	14.00	30
2019	16,405	14.00	30
2020	16,614	14.00	30
2021	16,824	14.00	31
2022	17,033	14.00	31
2023	17,243	14.00	31
2024	17,612	14.00	32

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.47% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 45 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	29	31	45	4	10	14	61
2017	2	29	31	45	4	12	16	60
2018	1	30	31	46	5	14	19	58
2019	1	30	31	47	6	16	22	56
2020	0	30	31	48	7	18	25	54
2021	0	31	31	49	9	20	29	50
2022	0	31	31	50	10	22	33	48
2023	0	31	31	50	12	25	37	45
2024	0	32	32	51	14	27	41	43
2025	0	33	33	52	15	29	44	40
2026	0	33	33	53	17	31	48	38
2027	0	34	34	54	19	34	52	36
2028	0	35	35	55	20	36	56	33
2029	0	36	36	55	22	38	60	31
2030	0	36	36	56	23	40	64	29
2031	0	37	37	57	25	43	68	26
2032	0	38	38	57	27	45	72	23
2033	0	38	38	58	29	47	76	20
2034	0	39	39	59	31	50	80	17
2035	0	39	39	59	32	52	84	14
2036	0	40	40	60	34	54	89	11
2037	0	40	40	60	36	57	93	8
2038	0	41	41	61	38	59	97	5
2039	0	41	41	62	40	61	101	2
2040	0	42	42	62	41	64	105	(1)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	29	31	11	4	10	14	28
2017	2	29	31	11	4	12	16	26
2018	1	30	31	11	5	14	19	23
2019	1	30	31	12	6	16	22	21
2020	0	30	31	12	7	18	25	17
2021	0	31	31	12	9	20	29	14
2022	0	31	31	12	10	22	33	10
2023	0	31	31	12	12	25	37	7
2024	0	32	32	13	14	27	41	4
2025	0	33	33	13	15	29	44	1
2026	0	33	33	13	17	31	48	(2)
2027	0	34	34	13	19	34	52	(5)
2028	0	35	35	13	20	36	56	(8)
2029	0	36	36	14	22	38	60	(11)
2030	0	36	36	14	23	40	64	(14)
2031	0	37	37	14	25	43	68	(17)
2032	0	38	38	14	27	45	72	(20)
2033	0	38	38	14	29	47	76	(24)
2034	0	39	39	14	31	50	80	(27)
2035	0	39	39	15	32	52	84	(31)
2036	0	40	40	15	34	54	89	(34)
2037	0	40	40	15	36	57	93	(38)
2038	0	41	41	15	38	59	97	(41)
2039	0	41	41	15	40	61	101	(45)
2040	0	42	42	15	41	64	105	(48)

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 16 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	29	31	16	4	10	14	33
2017	2	29	31	17	4	12	16	31
2018	1	30	31	17	5	14	19	29
2019	1	30	31	17	6	16	22	26
2020	0	30	31	18	7	18	25	23
2021	0	31	31	18	9	20	29	20
2022	0	31	31	18	10	22	33	16
2023	0	31	31	18	12	25	37	13
2024	0	32	32	19	14	27	41	10
2025	0	33	33	19	15	29	44	7
2026	0	33	33	19	17	31	48	4
2027	0	34	34	20	19	34	52	2
2028	0	35	35	20	20	36	56	(1)
2029	0	36	36	20	22	38	60	(4)
2030	0	36	36	21	23	40	64	(7)
2031	0	37	37	21	25	43	68	(10)
2032	0	38	38	21	27	45	72	(14)
2033	0	38	38	21	29	47	76	(17)
2034	0	39	39	21	31	50	80	(20)
2035	0	39	39	22	32	52	84	(24)
2036	0	40	40	22	34	54	89	(27)
2037	0	40	40	22	36	57	93	(30)
2038	0	41	41	22	38	59	97	(34)
2039	0	41	41	23	40	61	101	(37)
2040	0	42	42	23	41	64	105	(41)

4. Rain Barrels

- **a.** In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Huntsville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Huntsville's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Huntsville's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Huntsville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Huntsville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	22.2	0	22	0	0	0	22
2016	24.8	0	25	0	0	0	25
2017	25.2	0	25	0	0	0	25
2018	25.7	0	26	0	0	0	26
2019	26.2	0	26	0	0	0	26
2020	26.6	0	27	0	0	0	27
2021	27.1	0	27	0	0	0	27
2022	27.6	0	28	0	0	0	28
2023	28.0	0	28	0	0	0	28
2024	28.5	0	28	0	0	0	28
2025	28.9	0	29	0	0	0	29
2026	29.4	0	29	0	0	0	29
2027	29.9	0	30	0	0	0	30
2028	30.3	0	30	0	0	0	30
2029	30.8	0	31	0	0	0	31
2030	31.3	0	31	0	0	0	31
2031	31.6	0	32	0	0	0	32
2032	31.9	0	32	0	0	0	32
2033	32.3	0	32	0	0	0	32
2034	32.6	0	33	0	0	0	33
2035	32.9	0	33	0	0	0	33
2036	33.3	0	33	0	0	0	33
2037	33.6	0	34	0	0	0	34
2038	33.9	0	34	0	0	0	34
2039	34.3	0	34	0	0	0	34
2040	34.6	0	35	0	0	0	35
2041	34.9	0	35	0	0	0	35
2042	35.1	0	35	0	0	0	35
2043	35.4	0	35	0	0	0	35
2044	35.6	0	36	0	0	0	36
2045	35.9	0	36	0	0	0	36
2046	36.2	0	36	0	0	0	36
2047	36.4	0	36	0	0	0	36
2048	36.7	0	37	0	0	0	37
2049	36.9	0	37	0	0	0	37
2050	37.2	0	37	0	0	0	37
2051	37.4	0	37	0	0	0	37
2052	37.6	0	38	0	0	0	38
2053	37.8	0	38	0	0	0	38
2054	38.0	0	38	0	0	0	38
2055	38.2	0	38	0	0	0	38
2056	38.4	0	38	0	0	0	38
2057	38.6	0	39	0	0	0	39
2058	38.8	0	39	0	0	0	39
2059	39.0	0	39	0	0	0	39
2060	39.3	0	39	0	0	0	39
2061	39.4	0	39	0	0	0	39
2062	39.6	0	40	0	0	0	40
2063	39.7	0	40	0	0	0	40
2064	39.9	0	40	0	0	0	40
2065	40.0	0	40	0	0	0	40
2066	40.2	0	40	0	0	0	40
2067	40.4	0	40	0	0	0	40
2068	40.5	0	41	0	0	0	41
2069	40.7	0	41	0	0	0	41
2070	40.8	0	41	0	0	0	41

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Huntsville's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	302	0	0	0
1	2015	39,765	282	296	22	(274)
2	2016	39,970	261	595	25	(570)
3	2017	40,174	241	897	25	(872)
4	2018	40,379	220	1,203	26	(1,177)
5-year Goal	2019	40,583	200	1,511	26	(1,485)
6	2020	40,788	199	1,533	27	(1,507)
7	2021	40,984	198	1,556	27	(1,529)
8	2022	41,180	197	1,578	28	(1,551)
9	2023	41,375	196	1,601	28	(1,573)
10-year Goal	2024	41,571	195	1,624	28	(1,595)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Huntsville's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	39,765	20.00	0	0	0
2	2016	39,970	20.00	0	0	0
3	2017	40,174	20.00	0	0	0
4	2018	40,379	20.00	0	0	0
5-year Goal	2019	40,583	20.00	0	0	0
6	2020	40,788	20.00	0	0	0
7	2021	40,984	20.00	0	0	0
8	2022	41,180	20.00	0	0	0
9	2023	41,375	20.00	0	0	0
10-year Goal	2024	41,571	20.00	0	0	0

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 1.39% increase in 2015
        ii. 1.39% increase in 2016
    b. Estimated customer demand reduction of .54%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
        i. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increases	Outdoor Landscape Evaluations (SF/MF)	TOTAL SAVINGS
2009				0
2010				0
2011				0
2012				0
2013	19			19.2
2014	20			19.6
2015	20	2		22.2
2016	20	4		24.8
2017	21	4		25.2
2018	21	5		25.7
2019	22	5		26.2
2020	22	5		26.6
2021	22	5		27.1
2022	23	5		27.6
2023	23	5		28.0
2024	23	5		28.5
2025	24	5		28.9
2026	24	5		29.4
2027	25	5		29.9
2028	25	5		30.3
2029	25	5		30.8
2030	26	6		31.3
2031	26	6		31.6
2032	26	6		31.9
2033	27	6		32.3
2034	27	6		32.6
2035	27	6		32.9
2036	27	6		33.3
2037	28	6		33.6
2038	28	6		33.9
2039	28	6		34.3
2040	28	6		34.6
2041	29	6		34.9
2042	29	6		35.1
2043	29	6		35.4
2044	29	6		35.6
2045	30	6		35.9
2046	30	6		36.2
2047	30	6		36.4
2048	30	7		36.7
2049	30	7		36.9
2050	31	7		37.2
2051	31	7		37.4
2052	31	7		37.6
2053	31	7		37.8
2054	31	7		38.0
2055	31	7		38.2
2056	32	7		38.4
2057	32	7		38.6
2058	32	7		38.8
2059	32	7		39.0
2060	32	7		39.3
2061	32	7		39.4
2062	33	7		39.6
2063	33	7		39.7
2064	33	7		39.9
2065	33	7		40.0
2066	33	7		40.2
2067	33	7		40.4
2068	33	7		40.5
2069	33	7		40.7
2070	34	7		40.8

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	39,161	20.00	0
2016	39,362	20.00	0
2017	39,564	20.00	0
2018	39,765	20.00	0
2019	39,970	20.00	0
2020	40,174	20.00	0
2021	40,379	20.00	0
2022	40,583	20.00	0
2023	40,788	20.00	0
2024	40,984	20.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 102 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	25	0	25	102	0	0	0	127
2017	25	0	25	102	0	0	0	127
2018	26	0	26	102	0	0	0	128
2019	26	0	26	103	0	0	0	129
2020	27	0	27	103	0	0	0	130
2021	27	0	27	103	0	0	0	130
2022	28	0	28	103	0	0	0	131
2023	28	0	28	104	0	0	0	132
2024	28	0	28	104	0	0	0	132
2025	29	0	29	104	0	0	0	133
2026	29	0	29	104	0	0	0	134
2027	30	0	30	105	0	0	0	135
2028	30	0	30	105	0	0	0	135
2029	31	0	31	105	0	0	0	136
2030	31	0	31	105	0	0	0	137
2031	32	0	32	106	0	0	0	137
2032	32	0	32	106	0	0	0	138
2033	32	0	32	106	0	0	0	138
2034	33	0	33	106	0	0	0	139
2035	33	0	33	106	0	0	0	139
2036	33	0	33	106	0	0	0	140
2037	34	0	34	107	0	0	0	140
2038	34	0	34	107	0	0	0	141
2039	34	0	34	107	0	0	0	141
2040	35	0	35	107	0	0	0	142

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	25	0	25	34	0	0	0	59
2017	25	0	25	34	0	0	0	59
2018	26	0	26	34	0	0	0	60
2019	26	0	26	34	0	0	0	61
2020	27	0	27	34	0	0	0	61
2021	27	0	27	35	0	0	0	62
2022	28	0	28	35	0	0	0	62
2023	28	0	28	35	0	0	0	63
2024	28	0	28	35	0	0	0	63
2025	29	0	29	35	0	0	0	64
2026	29	0	29	35	0	0	0	64
2027	30	0	30	35	0	0	0	65
2028	30	0	30	35	0	0	0	66
2029	31	0	31	35	0	0	0	66
2030	31	0	31	35	0	0	0	67
2031	32	0	32	35	0	0	0	67
2032	32	0	32	35	0	0	0	67
2033	32	0	32	35	0	0	0	68
2034	33	0	33	36	0	0	0	68
2035	33	0	33	36	0	0	0	69
2036	33	0	33	36	0	0	0	69
2037	34	0	34	36	0	0	0	69
2038	34	0	34	36	0	0	0	70
2039	34	0	34	36	0	0	0	70
2040	35	0	35	36	0	0	0	70

3. Rain Barrels
   a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Jersey Village Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Jersey Village's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Jersey Village's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Jersey Village's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Jersey Village with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.9	19.6	20.5	2	0	2	18
2016	0.9	19.6	20.5	3	0	3	18
2017	0.7	19.6	20.3	3	0	3	18
2018	0.6	19.6	20.2	3	0	3	17
2019	0.4	19.6	20.0	4	0	4	16
2020	0.2	19.7	19.8	5	0	5	15
2021	0	19.7	19.7	5	0	5	14
2022	0	19.7	19.7	6	0	6	13
2023	0	19.7	19.7	7	0	7	13
2024	0	19.7	19.7	8	0	8	12
2025	0	19.8	19.8	9	0	9	11
2026	0	19.8	19.8	10	0	10	10
2027	0	19.8	19.8	10	0	10	9
2028	0	19.8	19.8	11	0	11	8
2029	0	19.8	19.8	12	0	12	8
2030	0	19.9	19.9	13	0	13	7
2031	0	19.9	19.9	14	0	14	6
2032	0	19.9	19.9	15	0	15	5
2033	0	19.9	19.9	15	0	15	5
2034	0	19.9	19.9	16	0	16	4
2035	0	20.0	20.0	17	0	17	3
2036	0	20.0	20.0	18	0	18	2
2037	0	20.1	20.1	18	0	18	2
2038	0	20.1	20.1	19	0	19	1
2039	0	20.1	20.1	20	0	20	0
2040	0	20.2	20.2	21	0	21	(0)
2041	0	20.2	20.2	21	0	21	(1)
2042	0	20.2	20.2	22	0	22	(2)
2043	0	20.3	20.3	23	0	23	(2)
2044	0	20.3	20.3	23	0	23	(3)
2045	0	20.4	20.4	24	0	24	(4)
2046	0	20.4	20.4	25	0	25	(4)
2047	0	20.4	20.4	26	0	26	(5)
2048	0	20.5	20.5	26	0	26	(6)
2049	0	20.5	20.5	27	0	27	(6)
2050	0	20.6	20.6	28	0	28	(7)
2051	0	20.6	20.6	28	0	28	(8)
2052	0	20.6	20.6	29	0	29	(8)
2053	0	20.7	20.7	30	0	30	(9)
2054	0	20.7	20.7	31	0	31	(10)
2055	0	20.8	20.8	31	0	31	(11)
2056	0	20.8	20.8	32	0	32	(11)
2057	0	20.9	20.9	33	0	33	(12)
2058	0	20.9	20.9	33	0	33	(13)
2059	0	21.0	21.0	34	0	34	(13)
2060	0	21.0	21.0	35	0	35	(14)
2061	0	21.0	21.0	36	0	36	(14)
2062	0	21.1	21.1	36	0	36	(15)
2063	0	21.1	21.1	37	0	37	(16)
2064	0	21.2	21.2	37	0	37	(16)
2065	0	21.2	21.2	38	0	38	(17)
2066	0	21.3	21.3	39	0	39	(17)
2067	0	21.3	21.3	39	0	39	(18)
2068	0	21.4	21.4	40	0	40	(19)
2069	0	21.4	21.4	41	0	41	(19)
2070	0	21.5	21.5	41	0	41	(20)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Jersey Village's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline		184	0	0	0
1	2015	7,680	183	2	20.5	18
2	2016	7,689	182	4	20.5	16
3	2017	7,697	182	7	20.3	14
4	2018	7,706	181	9	20.2	11
5-year Goal	2019	7,714	180	11	20.0	9
6	2,020	7,723	178	16	20	3
7	2,021	7,730	176	21	20	(2)
8	2,022	7,736	175	27	20	(7)
9	2,023	7,743	173	32	20	(12)
10-year Goal	2,024	7,750	171	37	20	(17)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Jersey Village's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	7,680	17.40	2	19.6	18
2	2016	7,689	16.80	3	19.6	16
3	2017	7,697	16.20	5	19.6	15
4	2018	7,706	15.60	7	19.6	13
5-year Goal	2019	7,714	15.00	8	19.6	11
6	2020	7,723	14.40	10	19.7	10
7	2021	7,730	13.80	12	19.7	8
8	2022	7,736	13.20	14	19.7	6
9	2023	7,743	12.60	15	19.7	4
10-year Goal	2024	7,750	12.00	17	19.7	3

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 20 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.2	0.2
2010	0.3	0.3
2011	0.5	0.5
2012	0.7	0.7
2013	0.9	0.9
2014	0.9	0.9
2015	0.9	0.9
2016	0.9	0.9
2017	0.7	0.7
2018	0.6	0.6
2019	0.4	0.4
2020	0.2	0.2
2021		0
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	7,654	11.00	20
2016	7,663	11.00	20
2017	7,671	11.00	20
2018	7,680	11.00	20
2019	7,689	11.00	20
2020	7,697	11.00	20
2021	7,706	11.00	20
2022	7,714	11.00	20
2023	7,723	11.00	20
2024	7,730	11.00	20

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 23 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	20	20	23	3	0	3	41
2017	1	20	20	23	3	0	3	41
2018	1	20	20	23	3	0	3	40
2019	0	20	20	23	4	0	4	39
2020	0	20	20	23	5	0	5	38
2021	0	20	20	23	5	0	5	37
2022	0	20	20	23	6	0	6	36
2023	0	20	20	23	7	0	7	35
2024	0	20	20	23	8	0	8	34
2025	0	20	20	23	9	0	9	34
2026	0	20	20	23	10	0	10	33
2027	0	20	20	23	10	0	10	32
2028	0	20	20	23	11	0	11	31
2029	0	20	20	23	12	0	12	30
2030	0	20	20	23	13	0	13	29
2031	0	20	20	23	14	0	14	29
2032	0	20	20	23	15	0	15	28
2033	0	20	20	23	15	0	15	27
2034	0	20	20	23	16	0	16	27
2035	0	20	20	23	17	0	17	26
2036	0	20	20	23	18	0	18	25
2037	0	20	20	23	18	0	18	24
2038	0	20	20	23	19	0	19	24
2039	0	20	20	23	20	0	20	23
2040	0	20	20	23	21	0	21	22

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	20	20	8	3	0	3	26
2017	1	20	20	8	3	0	3	25
2018	1	20	20	8	3	0	3	25
2019	0	20	20	8	4	0	4	24
2020	0	20	20	8	5	0	5	23
2021	0	20	20	8	5	0	5	22
2022	0	20	20	8	6	0	6	21
2023	0	20	20	8	7	0	7	20
2024	0	20	20	8	8	0	8	19
2025	0	20	20	8	9	0	9	19
2026	0	20	20	8	10	0	10	18
2027	0	20	20	8	10	0	10	17
2028	0	20	20	8	11	0	11	16
2029	0	20	20	8	12	0	12	15
2030	0	20	20	8	13	0	13	14
2031	0	20	20	8	14	0	14	14
2032	0	20	20	8	15	0	15	13
2033	0	20	20	8	15	0	15	12
2034	0	20	20	8	16	0	16	11
2035	0	20	20	8	17	0	17	11
2036	0	20	20	8	18	0	18	10
2037	0	20	20	8	18	0	18	9
2038	0	20	20	8	19	0	19	9
2039	0	20	20	8	20	0	20	8
2040	0	20	20	8	21	0	21	7

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 11 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	20	20	11	3	0	3	29
2017	1	20	20	11	3	0	3	29
2018	1	20	20	11	3	0	3	29
2019	0	20	20	11	4	0	4	28
2020	0	20	20	11	5	0	5	27
2021	0	20	20	11	5	0	5	26
2022	0	20	20	11	6	0	6	25
2023	0	20	20	11	7	0	7	24
2024	0	20	20	11	8	0	8	23
2025	0	20	20	11	9	0	9	22
2026	0	20	20	11	10	0	10	21
2027	0	20	20	11	10	0	10	21
2028	0	20	20	11	11	0	11	20
2029	0	20	20	11	12	0	12	19
2030	0	20	20	11	13	0	13	18
2031	0	20	20	11	14	0	14	17
2032	0	20	20	11	15	0	15	17
2033	0	20	20	11	15	0	15	16
2034	0	20	20	11	16	0	16	15
2035	0	20	20	11	17	0	17	15
2036	0	20	20	11	18	0	18	14
2037	0	20	20	11	18	0	18	13
2038	0	20	20	11	19	0	19	12
2039	0	20	20	11	20	0	20	12
2040	0	20	20	11	21	0	21	11

4. Rain Barrels
   - **a.** In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   - **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Katy Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Katy's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Katy's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Katy's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Katy with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with

---

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	2.5	(23)	(20)	5	0	5	(25)
2016	2.5	(24)	(21)	7	0	7	(28)
2017	2.1	(25)	(23)	7	0	7	(29)
2018	1.5	(26)	(24)	8	0	8	(32)
2019	1.0	(27)	(26)	9	0	9	(35)
2020	0.5	(28)	(28)	12	0	12	(39)
2021	0	(29)	(29)	15	0	15	(44)
2022	0	(30)	(30)	18	0	18	(48)
2023	0	(32)	(32)	21	0	21	(53)
2024	0	(33)	(33)	24	0	24	(57)
2025	0	(35)	(35)	27	0	27	(62)
2026	0	(36)	(36)	30	0	30	(66)
2027	0	(38)	(38)	33	0	33	(71)
2028	0	(39)	(39)	36	0	36	(75)
2029	0	(41)	(41)	39	0	39	(80)
2030	0	(42)	(42)	42	0	42	(84)
2031	0	(44)	(44)	44	0	44	(88)
2032	0	(45)	(45)	47	0	47	(92)
2033	0	(47)	(47)	49	0	49	(96)
2034	0	(47)	(47)	52	0	52	(98)
2035	0	(47)	(47)	54	0	54	(101)
2036	0	(47)	(47)	56	0	56	(103)
2037	0	(47)	(47)	59	0	59	(106)
2038	0	(47)	(47)	61	0	61	(108)
2039	0	(47)	(47)	63	0	63	(111)
2040	0	(48)	(48)	66	0	66	(113)
2041	0	(48)	(48)	68	0	68	(116)
2042	0	(48)	(48)	70	0	70	(118)
2043	0	(48)	(48)	72	0	72	(120)
2044	0	(48)	(48)	75	0	75	(123)
2045	0	(48)	(48)	77	0	77	(125)
2046	0	(49)	(49)	79	0	79	(127)
2047	0	(49)	(49)	81	0	81	(130)
2048	0	(49)	(49)	83	0	83	(132)
2049	0	(49)	(49)	85	0	85	(134)
2050	0	(49)	(49)	88	0	88	(137)
2051	0	(49)	(49)	90	0	90	(139)
2052	0	(49)	(49)	92	0	92	(141)
2053	0	(49)	(49)	94	0	94	(143)
2054	0	(50)	(50)	96	0	96	(145)
2055	0	(50)	(50)	98	0	98	(147)
2056	0	(50)	(50)	100	0	100	(150)
2057	0	(50)	(50)	102	0	102	(152)
2058	0	(50)	(50)	104	0	104	(154)
2059	0	(50)	(50)	106	0	106	(156)
2060	0	(50)	(50)	108	0	108	(158)
2061	0	(51)	(51)	109	0	109	(160)
2062	0	(51)	(51)	111	0	111	(162)
2063	0	(51)	(51)	113	0	113	(164)
2064	0	(51)	(51)	115	0	115	(166)
2065	0	(51)	(51)	117	0	117	(168)
2066	0	(51)	(51)	118	0	118	(170)
2067	0	(51)	(51)	120	0	120	(172)
2068	0	(52)	(52)	122	0	122	(174)
2069	0	(52)	(52)	124	0	124	(176)
2070	0	(52)	(52)	126	0	126	(178)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Katy's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	184	0	0	0
1	2015	17,510	182	12	(20)	(32)
2	2016	18,351	180	24	(21)	(45)
3	2017	19,191	179	38	(23)	(60)
4	2018	20,032	177	53	(24)	(77)
5-year Goal	2019	20,872	175	69	(26)	(94)
6	2020	21,713	173	86	(28)	(113)
7	2021	22,733	171	105	(29)	(134)
8	2022	23,753	170	125	(30)	(155)
9	2023	24,773	168	146	(32)	(178)
10-year Goal	2024	25,793	166	169	(33)	(203)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Katy's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2015	17,510	8.80	1	(23)	(24)
2	2016	18,351	8.60	3	(24)	(26)
3	2017	19,191	8.40	4	(25)	(29)
4	2018	20,032	8.20	6	(26)	(31)
5-year Goal	2019	20,872	8.00	8	(27)	(34)
6	2020	21,713	8.00	8	(28)	(36)
7	2021	22,733	8.00	8	(29)	(38)
8	2022	23,753	8.00	9	(30)	(39)
9	2023	24,773	8.00	9	(32)	(41)
10-year Goal	2024	25,793	8.00	9	(33)	(43)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 23 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.5	0.5
2010	1.0	1.0
2011	1.5	1.5
2012	1.9	1.9
2013	2.4	2.4
2014	2.5	2.5
2015	2.5	2.5
2016	2.5	2.5
2017	2.1	2.1
2018	1.5	1.5
2019	1.0	1.0
2020	0.5	0.5
2021		0
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	15,504	13.00	(23)
2016	16,173	13.00	(24)
2017	16,841	13.00	(25)
2018	17,510	13.00	(26)
2019	18,351	13.00	(27)
2020	19,191	13.00	(28)
2021	20,032	13.00	(29)
2022	20,872	13.00	(30)
2023	21,713	13.00	(32)
2024	22,733	13.00	(33)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 56 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	3	(24)	(21)	56	7	0	7	28
2017	2	(25)	(23)	59	7	0	7	30
2018	2	(26)	(24)	62	8	0	8	30
2019	1	(27)	(26)	65	9	0	9	30
2020	0	(28)	(28)	68	12	0	12	29
2021	0	(29)	(29)	71	15	0	15	27
2022	0	(30)	(30)	74	18	0	18	26
2023	0	(32)	(32)	77	21	0	21	25
2024	0	(33)	(33)	80	24	0	24	23
2025	0	(35)	(35)	83	27	0	27	22
2026	0	(36)	(36)	86	30	0	30	20
2027	0	(38)	(38)	89	33	0	33	19
2028	0	(39)	(39)	92	36	0	36	17
2029	0	(41)	(41)	95	39	0	39	16
2030	0	(42)	(42)	98	42	0	42	14
2031	0	(44)	(44)	99	44	0	44	11
2032	0	(45)	(45)	99	47	0	47	7
2033	0	(47)	(47)	99	49	0	49	3
2034	0	(47)	(47)	99	52	0	52	1
2035	0	(47)	(47)	100	54	0	54	(1)
2036	0	(47)	(47)	100	56	0	56	(3)
2037	0	(47)	(47)	100	59	0	59	(6)
2038	0	(47)	(47)	100	61	0	61	(8)
2039	0	(47)	(47)	101	63	0	63	(10)
2040	0	(48)	(48)	101	66	0	66	(12)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	3	(24)	(21)	19	7	0	7	(9)
2017	2	(25)	(23)	20	7	0	7	(9)
2018	2	(26)	(24)	21	8	0	8	(11)
2019	1	(27)	(26)	22	9	0	9	(13)
2020	0	(28)	(28)	23	12	0	12	(16)
2021	0	(29)	(29)	24	15	0	15	(20)
2022	0	(30)	(30)	25	18	0	18	(23)
2023	0	(32)	(32)	26	21	0	21	(27)
2024	0	(33)	(33)	27	24	0	24	(30)
2025	0	(35)	(35)	28	27	0	27	(34)
2026	0	(36)	(36)	29	30	0	30	(37)
2027	0	(38)	(38)	30	33	0	33	(41)
2028	0	(39)	(39)	31	36	0	36	(44)
2029	0	(41)	(41)	32	39	0	39	(48)
2030	0	(42)	(42)	33	42	0	42	(51)
2031	0	(44)	(44)	33	44	0	44	(55)
2032	0	(45)	(45)	33	47	0	47	(59)
2033	0	(47)	(47)	33	49	0	49	(63)
2034	0	(47)	(47)	33	52	0	52	(65)
2035	0	(47)	(47)	33	54	0	54	(67)
2036	0	(47)	(47)	33	56	0	56	(70)
2037	0	(47)	(47)	34	59	0	59	(72)
2038	0	(47)	(47)	34	61	0	61	(75)
2039	0	(47)	(47)	34	63	0	63	(77)
2040	0	(48)	(48)	34	66	0	66	(80)

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 28 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	3	(24)	(21)	28	7	0	7	0
2017	2	(25)	(23)	30	7	0	7	1
2018	2	(26)	(24)	31	8	0	8	(1)
2019	1	(27)	(26)	33	9	0	9	(2)
2020	0	(28)	(28)	34	12	0	12	(5)
2021	0	(29)	(29)	36	15	0	15	(8)
2022	0	(30)	(30)	37	18	0	18	(11)
2023	0	(32)	(32)	39	21	0	21	(14)
2024	0	(33)	(33)	40	24	0	24	(17)
2025	0	(35)	(35)	42	27	0	27	(20)
2026	0	(36)	(36)	43	30	0	30	(23)
2027	0	(38)	(38)	45	33	0	33	(26)
2028	0	(39)	(39)	46	36	0	36	(29)
2029	0	(41)	(41)	48	39	0	39	(32)
2030	0	(42)	(42)	49	42	0	42	(35)
2031	0	(44)	(44)	49	44	0	44	(39)
2032	0	(45)	(45)	49	47	0	47	(42)
2033	0	(47)	(47)	50	49	0	49	(46)
2034	0	(47)	(47)	50	52	0	52	(49)
2035	0	(47)	(47)	50	54	0	54	(51)
2036	0	(47)	(47)	50	56	0	56	(53)
2037	0	(47)	(47)	50	59	0	59	(56)
2038	0	(47)	(47)	50	61	0	61	(58)
2039	0	(47)	(47)	50	63	0	63	(61)
2040	0	(48)	(48)	51	66	0	66	(63)

4. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Lake Jackson Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Lake Jackson's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Lake Jackson's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Lake Jackson's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Lake Jackson with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	69	69	8	12	21	48
2016	0	69	69	10	16	26	43
2017	0	69	69	10	19	29	40
2018	0	69	69	12	22	34	35
2019	0	69	69	14	25	39	30
2020	0	69	69	18	28	46	23
2021	0	70	70	21	31	52	18
2022	0	70	70	24	33	57	12
2023	0	70	70	27	36	63	7
2024	0	70	70	31	38	69	1
2025	0	70	70	34	41	74	(4)
2026	0	70	70	37	43	80	(10)
2027	0	71	71	40	46	86	(15)
2028	0	71	71	43	48	91	(20)
2029	0	71	71	46	51	97	(26)
2030	0	71	71	49	53	102	(31)
2031	0	71	71	51	56	107	(36)
2032	0	72	72	54	58	112	(41)
2033	0	72	72	57	61	117	(45)
2034	0	72	72	59	63	122	(50)
2035	0	72	72	62	65	127	(55)
2036	0	72	72	64	68	132	(59)
2037	0	73	73	67	70	137	(64)
2038	0	73	73	69	72	142	(69)
2039	0	73	73	72	75	147	(74)
2040	0	73	73	74	77	152	(78)
2041	0	73	73	76	80	156	(82)
2042	0	74	74	79	82	160	(87)
2043	0	74	74	81	84	165	(91)
2044	0	74	74	83	86	169	(95)
2045	0	74	74	85	89	174	(99)
2046	0	75	75	87	91	178	(103)
2047	0	75	75	89	93	182	(107)
2048	0	75	75	91	95	187	(112)
2049	0	75	75	93	98	191	(116)
2050	0	76	76	95	100	196	(120)
2051	0	76	76	97	102	200	(124)
2052	0	76	76	99	105	204	(128)
2053	0	76	76	101	107	208	(132)
2054	0	77	77	103	109	212	(135)
2055	0	77	77	104	112	216	(139)
2056	0	77	77	106	114	220	(143)
2057	0	77	77	108	116	224	(147)
2058	0	78	78	110	119	228	(151)
2059	0	78	78	112	121	232	(155)
2060	0	78	78	113	123	237	(159)
2061	0	78	78	115	124	239	(161)
2062	0	79	79	116	125	241	(163)
2063	0	79	79	118	126	244	(165)
2064	0	79	79	120	126	246	(167)
2065	0	79	79	121	127	248	(169)
2066	0	80	80	123	128	250	(171)
2067	0	80	80	124	129	253	(173)
2068	0	80	80	126	129	255	(175)
2069	0	80	80	127	130	257	(177)
2070	0	81	81	129	131	260	(179)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Lake Jackson's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	152	0	0	0
1	2016	27,158	150	16	69	53
2	2017	27,195	149	32	69	37
3	2018	27,233	147	48	69	21
4	2019	27,270	146	64	69	6
5-year Goal	2,020	27,308	144	80	69	(10)
6	2,021	27,387	143	94	69	(24)
7	2,022	27,466	141	108	70	(39)
8	2,023	27,544	140	123	70	(53)
9	2,024	27,623	138	137	70	(67)
10-year Goal	2,025	27,702	137	152	70	(82)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Lake Jackson's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	30.00	0	0	0
1	2016	27,158	29.80	2	69	67
2	2017	27,195	29.60	4	69	65
3	2018	27,233	29.40	6	69	63
4	2019	27,270	29.20	8	69	61
5-year Goal	2020	27,308	29.00	10	69	59
6	2021	27,387	28.60	14	69	55
7	2022	27,466	28.20	18	70	52
8	2023	27,544	27.80	22	70	48
9	2024	27,623	27.40	26	70	44
10-year Goal	2025	27,702	27.00	30	70	40

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 69 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
        i. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	30.00	0
2014	27,061	23.00	69
2015	27,120	23.00	69
2016	27,158	23.00	69
2017	27,195	23.00	69
2018	27,233	23.00	70
2019	27,270	23.00	70
2020	27,308	23.00	70
2021	27,387	23.00	70
2022	27,466	23.00	70
2023	27,544	23.00	70

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

- The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 69 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	69	69	69	10	16	26	112
2017	0	69	69	69	10	19	29	110
2018	0	69	69	69	12	22	34	105
2019	0	69	69	69	14	25	39	100
2020	0	69	69	69	18	28	46	93
2021	0	70	70	69	21	31	52	87
2022	0	70	70	69	24	33	57	82
2023	0	70	70	69	27	36	63	76
2024	0	70	70	69	31	38	69	71
2025	0	70	70	70	34	41	74	65
2026	0	70	70	70	37	43	80	60
2027	0	71	71	70	40	46	86	55
2028	0	71	71	70	43	48	91	49
2029	0	71	71	70	46	51	97	44
2030	0	71	71	70	49	53	102	39
2031	0	71	71	70	51	56	107	34
2032	0	72	72	70	54	58	112	29
2033	0	72	72	70	57	61	117	25
2034	0	72	72	70	59	63	122	20
2035	0	72	72	70	62	65	127	15
2036	0	72	72	70	64	68	132	11
2037	0	73	73	70	67	70	137	6
2038	0	73	73	70	69	72	142	1
2039	0	73	73	70	72	75	147	(3)
2040	0	73	73	70	74	77	152	(8)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	69	69	23	10	16	26	66
2017	0	69	69	23	10	19	29	64
2018	0	69	69	23	12	22	34	59
2019	0	69	69	23	14	25	39	54
2020	0	69	69	23	18	28	46	46
2021	0	70	70	23	21	31	52	41
2022	0	70	70	23	24	33	57	35
2023	0	70	70	23	27	36	63	30
2024	0	70	70	23	31	38	69	25
2025	0	70	70	23	34	41	74	19
2026	0	70	70	23	37	43	80	14
2027	0	71	71	23	40	46	86	8
2028	0	71	71	23	43	48	91	3
2029	0	71	71	23	46	51	97	(2)
2030	0	71	71	23	49	53	102	(8)
2031	0	71	71	23	51	56	107	(13)
2032	0	72	72	23	54	58	112	(17)
2033	0	72	72	23	57	61	117	(22)
2034	0	72	72	23	59	63	122	(27)
2035	0	72	72	23	62	65	127	(31)
2036	0	72	72	23	64	68	132	(36)
2037	0	73	73	24	67	70	137	(41)
2038	0	73	73	24	69	72	142	(45)
2039	0	73	73	24	72	75	147	(50)
2040	0	73	73	24	74	77	152	(55)

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 35 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	69	69	35	10	16	26	78
2017	0	69	69	35	10	19	29	75
2018	0	69	69	35	12	22	34	70
2019	0	69	69	35	14	25	39	65
2020	0	69	69	35	18	28	46	58
2021	0	70	70	35	21	31	52	52
2022	0	70	70	35	24	33	57	47
2023	0	70	70	35	27	36	63	41
2024	0	70	70	35	31	38	69	36
2025	0	70	70	35	34	41	74	31
2026	0	70	70	35	37	43	80	25
2027	0	71	71	35	40	46	86	20
2028	0	71	71	35	43	48	91	14
2029	0	71	71	35	46	51	97	9
2030	0	71	71	35	49	53	102	4
2031	0	71	71	35	51	56	107	(1)
2032	0	72	72	35	54	58	112	(6)
2033	0	72	72	35	57	61	117	(10)
2034	0	72	72	35	59	63	122	(15)
2035	0	72	72	35	62	65	127	(20)
2036	0	72	72	35	64	68	132	(24)
2037	0	73	73	35	67	70	137	(29)
2038	0	73	73	35	69	72	142	(34)
2039	0	73	73	35	72	75	147	(38)
2040	0	73	73	35	74	77	152	(43)

4. Rain Barrels
   a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
League City Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares League City's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) League City's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in League City's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for League City with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	244	(97)	147	5	0	5	142
2016	247	(99)	148	6	0	6	141
2017	247	(102)	145	6	0	6	139
2018	246	(104)	142	8	0	8	135
2019	246	(107)	138	9	0	9	129
2020	245	(110)	135	11	0	11	123
2021	245	(114)	131	14	0	14	117
2022	247	(117)	130	16	0	16	114
2023	250	(120)	130	19	0	19	111
2024	252	(122)	131	21	0	21	109
2025	255	(123)	132	24	0	24	108
2026	257	(125)	133	26	0	26	106
2027	260	(126)	134	29	0	29	105
2028	262	(128)	135	31	0	31	103
2029	265	(129)	136	34	0	34	102
2030	267	(131)	137	36	0	36	100
2031	269	(132)	137	39	0	39	98
2032	271	(134)	137	41	0	41	96
2033	273	(135)	138	44	0	44	94
2034	275	(136)	139	46	0	46	92
2035	277	(138)	139	49	0	49	91
2036	279	(139)	140	51	0	51	89
2037	281	(140)	141	54	0	54	87
2038	283	(141)	142	57	0	57	85
2039	285	(142)	143	59	0	59	84
2040	287	(144)	143	62	0	62	82
2041	289	(145)	144	64	0	64	80
2042	290	(146)	144	67	0	67	78
2043	292	(147)	145	69	0	69	76
2044	294	(148)	146	72	0	72	74
2045	295	(149)	146	74	0	74	72
2046	297	(150)	147	77	0	77	70
2047	299	(151)	148	79	0	79	69
2048	300	(152)	148	82	0	82	67
2049	302	(153)	149	84	0	84	65
2050	304	(154)	150	87	0	87	63
2051	305	(155)	150	89	0	89	61
2052	306	(156)	150	91	0	91	59
2053	307	(157)	150	94	0	94	56
2054	308	(157)	150	96	0	96	54
2055	309	(158)	151	98	0	98	53
2056	310	(158)	151	101	0	101	51
2057	311	(159)	152	103	0	103	49
2058	312	(159)	152	105	0	105	47
2059	313	(160)	153	108	0	108	45
2060	314	(161)	153	110	0	110	43
2061	314	(161)	153	112	0	112	41
2062	315	(162)	154	115	0	115	39
2063	316	(162)	154	117	0	117	37
2064	317	(163)	154	119	0	119	35
2065	317	(163)	154	121	0	121	33
2066	318	(163)	155	123	0	123	31
2067	319	(164)	155	126	0	126	29
2068	320	(164)	155	128	0	128	28
2069	320	(164)	156	130	0	130	26
2070	321	(165)	156	132	0	132	24

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how League City's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	118	0	0	0
1	2015	95,002	118	14	147	134
2	2016	97,938	117	29	148	119
3	2017	100,874	117	44	145	101
4	2018	103,811	116	61	142	82
5-year Goal	2019	106,747	116	78	138	60
6	2020	109,683	115	128	135	7
7	2021	111,072	114	178	131	(47)
8	2022	112,462	112	230	130	(99)
9	2023	113,851	111	283	130	(153)
10-year Goal	2024	115,241	110	337	131	(206)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how League City's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	95,002	9.00	35	(97)	(132)
2	2016	97,938	8.00	71	(99)	(171)
3	2017	100,874	7.00	110	(102)	(212)
4	2018	103,811	6.00	152	(104)	(256)
5-year Goal	2019	106,747	5.00	195	(107)	(302)
6	2020	109,683	5.00	200	(110)	(311)
7	2021	111,072	5.00	203	(114)	(316)
8	2022	112,462	5.00	205	(117)	(322)
9	2023	113,851	5.00	208	(120)	(328)
10-year Goal	2024	115,241	5.00	210	(122)	(332)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 97 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 13.0% increase in 2015
    b. Estimated customer demand reduction of 2.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
    c. 15% adoption rate assumed

7. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increases	WaterWise Take-home Kits	TOTAL SAVINGS
2009			2.9	3
2010			5.5	5
2011			8.3	8
2012			10.9	11
2013			13.8	14
2014			14.1	14
2015	113	117	14.4	244
2016	114	118	14.4	247
2017	115	120	11.8	247
2018	116	121	8.8	246
2019	118	122	5.7	246
2020	119	124	2.8	245
2021	120	125		245
2022	121	126		247
2023	122	127		250
2024	124	129		252
2025	125	130		255
2026	126	131		257
2027	127	132		260
2028	129	134		262
2029	130	135		265
2030	131	136		267
2031	132	137		269
2032	133	138		271
2033	134	139		273
2034	135	140		275
2035	136	141		277
2036	137	142		279
2037	138	143		281
2038	139	144		283
2039	140	145		285
2040	141	146		287
2041	141	147		289
2042	142	148		290
2043	143	149		292
2044	144	150		294
2045	145	151		295
2046	146	151		297
2047	146	152		299
2048	147	153		300
2049	148	154		302
2050	149	155		304
2051	149	155		305
2052	150	156		306
2053	150	156		307
2054	151	157		308
2055	151	157		309
2056	152	158		310
2057	152	158		311
2058	153	159		312
2059	153	159		313
2060	154	160		314
2061	154	160		314
2062	155	161		315
2063	155	161		316
2064	155	161		317
2065	156	162		317
2066	156	162		318
2067	156	163		319
2068	157	163		320
2069	157	163		320
2070	157	164		321

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	88,459	13.00	(97)
2016	90,640	13.00	(99)
2017	92,821	13.00	(102)
2018	95,002	13.00	(104)
2019	97,938	13.00	(107)
2020	100,874	13.00	(110)
2021	103,811	13.00	(114)
2022	106,747	13.00	(117)
2023	109,683	13.00	(120)
2024	111,072	13.00	(122)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 182 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	247	(99)	148	182	6	0	6	324
2017	247	(102)	145	184	6	0	6	323
2018	246	(104)	142	186	8	0	8	321
2019	246	(107)	138	188	9	0	9	318
2020	245	(110)	135	190	11	0	11	313
2021	245	(114)	131	192	14	0	14	309
2022	247	(117)	130	194	16	0	16	308
2023	250	(120)	130	196	19	0	19	307
2024	252	(122)	131	198	21	0	21	307
2025	255	(123)	132	200	24	0	24	308
2026	257	(125)	133	202	26	0	26	308
2027	260	(126)	134	204	29	0	29	309
2028	262	(128)	135	206	31	0	31	309
2029	265	(129)	136	208	34	0	34	310
2030	267	(131)	137	210	36	0	36	310
2031	269	(132)	137	211	39	0	39	309
2032	271	(134)	137	213	41	0	41	309
2033	273	(135)	138	214	44	0	44	308
2034	275	(136)	139	216	46	0	46	308
2035	277	(138)	139	217	49	0	49	308
2036	279	(139)	140	219	51	0	51	308
2037	281	(140)	141	220	54	0	54	307
2038	283	(141)	142	222	57	0	57	307
2039	285	(142)	143	223	59	0	59	307
2040	287	(144)	143	225	62	0	62	307

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	247	(99)	148	61	6	0	6	202
2017	247	(102)	145	62	6	0	6	200
2018	246	(104)	142	62	8	0	8	197
2019	246	(107)	138	63	9	0	9	192
2020	245	(110)	135	64	11	0	11	187
2021	245	(114)	131	64	14	0	14	182
2022	247	(117)	130	65	16	0	16	179
2023	250	(120)	130	66	19	0	19	177
2024	252	(122)	131	66	21	0	21	176
2025	255	(123)	132	67	24	0	24	175
2026	257	(125)	133	68	26	0	26	174
2027	260	(126)	134	68	29	0	29	173
2028	262	(128)	135	69	31	0	31	172
2029	265	(129)	136	70	34	0	34	171
2030	267	(131)	137	70	36	0	36	171
2031	269	(132)	137	71	39	0	39	169
2032	271	(134)	137	71	41	0	41	167
2033	273	(135)	138	72	44	0	44	166
2034	275	(136)	139	72	46	0	46	165
2035	277	(138)	139	73	49	0	49	163
2036	279	(139)	140	73	51	0	51	162
2037	281	(140)	141	74	54	0	54	161
2038	283	(141)	142	74	57	0	57	160
2039	285	(142)	143	75	59	0	59	158
2040	287	(144)	143	75	62	0	62	157

3. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Pasadena Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Pasadena's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Pasadena's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Pasadena's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Pasadena with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,375	111	1,486	27	45	71	1,415
2016	1,375	111	1,487	33	56	89	1,398
2017	1,372	112	1,484	33	67	100	1,384
2018	1,368	113	1,481	40	78	118	1,363
2019	1,364	113	1,477	46	89	136	1,341
2020	1,361	113	1,474	60	100	160	1,314
2021	1,357	113	1,470	71	109	180	1,290
2022	1,357	113	1,470	82	118	200	1,270
2023	1,357	113	1,470	93	127	220	1,250
2024	1,357	113	1,470	104	136	240	1,230
2025	1,358	113	1,472	115	146	260	1,212
2026	1,358	114	1,472	126	155	280	1,192
2027	1,358	114	1,472	137	164	300	1,172
2028	1,358	114	1,473	148	173	320	1,152
2029	1,358	115	1,473	159	182	340	1,133
2030	1,358	115	1,473	170	191	360	1,113
2031	1,358	115	1,474	180	199	379	1,095
2032	1,358	116	1,474	190	207	397	1,077
2033	1,358	116	1,474	200	215	415	1,059
2034	1,358	116	1,475	210	224	434	1,041
2035	1,359	117	1,476	220	232	452	1,024
2036	1,359	117	1,476	230	240	471	1,006
2037	1,359	117	1,477	241	248	489	988
2038	1,359	118	1,477	251	257	507	970
2039	1,359	118	1,477	261	265	526	952
2040	1,359	118	1,478	271	273	544	934
2041	1,361	118	1,480	280	277	557	923
2042	1,363	119	1,482	290	280	570	912
2043	1,365	119	1,484	299	284	583	901
2044	1,366	119	1,486	309	287	596	890
2045	1,368	120	1,488	318	291	609	879
2046	1,370	120	1,490	328	294	622	868
2047	1,372	120	1,493	337	298	635	857
2048	1,374	121	1,495	347	302	648	847
2049	1,375	121	1,496	356	305	662	835
2050	1,377	121	1,499	366	309	675	824
2051	1,381	122	1,503	375	309	685	818
2052	1,384	122	1,506	384	310	694	812
2053	1,387	122	1,510	393	311	704	805
2054	1,390	123	1,513	403	312	714	799
2055	1,394	123	1,517	412	312	724	793
2056	1,397	123	1,521	421	313	734	787
2057	1,400	124	1,524	430	314	744	780
2058	1,403	124	1,527	439	315	754	773
2059	1,407	124	1,532	448	315	764	768
2060	1,410	125	1,535	458	316	774	761
2061	1,414	125	1,539	466	317	783	756
2062	1,417	125	1,543	475	318	793	750
2063	1,421	125	1,547	484	319	803	744
2064	1,425	126	1,551	493	319	812	739
2065	1,428	126	1,555	502	320	822	733
2066	1,432	126	1,559	510	321	831	728
2067	1,436	127	1,563	519	322	841	722
2068	1,439	127	1,567	528	323	851	716
2069	1,443	127	1,571	537	323	860	711
2070	1,447	128	1,575	546	324	870	705

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Pasadena's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	122	0	0	0
1	2015	154,250	121	34	1,486	1,452
2	2016	154,288	121	68	1,487	1,419
3	2017	154,326	120	101	1,484	1,383
4	2018	154,365	120	135	1,481	1,346
5-year Goal	2019	154,403	119	169	1,477	1,308
6	2020	154,441	118	209	1,474	1,265
7	2021	154,881	118	249	1,470	1,221
8	2022	155,321	117	289	1,470	1,181
9	2023	155,761	116	330	1,470	1,140
10-year Goal	2024	156,201	116	371	1,470	1,100

13 In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Pasadena's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	154,250	14.60	23	111	88
2	2016	154,288	14.20	45	111	66
3	2017	154,326	13.80	68	112	44
4	2018	154,365	13.40	90	113	22
5-year Goal	2019	154,403	13.00	113	113	(0)
6	2020	154,441	12.40	147	113	(34)
7	2021	154,881	11.80	181	113	(68)
8	2022	155,321	11.20	215	113	(103)
9	2023	155,761	10.60	250	113	(137)
10-year Goal	2024	156,201	10.00	285	113	(172)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 111 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 91.0% increase in 2012
    b. Estimated customer demand reduction of 18.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
    c. 15% adoption rate assumed

7. **Save Water Co. Commercial, Multi-family and Hotel Programs**[19]
    a. Project initiated in service area in 2014
    b. Save Water completed work on 44 multi-family units in June 2014.
    c. Average monthly savings of 286,156 gallons
    d. Annualized savings of 3.43 MG for the life of the retrofitted fixtures
    e. This study estimates a lifespan of 25 years for high-efficiency toilet replacements, five years for kitchen aerators and similar devices.
    f. Save Water Co. performs monthly meter readings before and after installation to quantify savings.
        i. The company's work consists of identifying and repairing all leaks and drips, rebuilding existing toilets and replacing sink aerators.

[19] Savings figures and units serviced based on personal email communication with Kurt Goedrich, December 1, 2016.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	WaterWise Take-home Kits	Save Water Co. Program	TOTAL SAVINGS
2009		3.7		4
2010		6.8		7
2011		10.3		10
2012	1,353	13.6		1,367
2013	1,353	17.3		1,370
2014	1,354	17.5	3.4	1,375
2015	1,354	17.9	3.4	1,375
2016	1,354	18.0	3.4	1,375
2017	1,354	14.7	3.4	1,372
2018	1,354	11.0	3.4	1,368
2019	1,354	7.1	3.4	1,364
2020	1,354	3.5	3.4	1,361
2021	1,354		3.4	1,357
2022	1,354		3.4	1,357
2023	1,354		3.4	1,357
2024	1,354		3.4	1,357
2025	1,355		3.4	1,358
2026	1,355		3.4	1,358
2027	1,355		3.4	1,358
2028	1,355		3.4	1,358
2029	1,355		3.4	1,358
2030	1,355		3.4	1,358
2031	1,355		3.4	1,358
2032	1,355		3.4	1,358
2033	1,355		3.4	1,358
2034	1,355		3.4	1,358
2035	1,356		3.4	1,359
2036	1,356		3.4	1,359
2037	1,356		3.4	1,359
2038	1,356		3.4	1,359
2039	1,356		3.4	1,359
2040	1,356		3.4	1,359
2041	1,358		3.4	1,361
2042	1,360		3.4	1,363
2043	1,362		3.4	1,365
2044	1,363		3.4	1,366
2045	1,365		3.4	1,368
2046	1,367		3.4	1,370
2047	1,369		3.4	1,372
2048	1,371		3.4	1,374
2049	1,372		3.4	1,375
2050	1,374		3.4	1,377
2051	1,378		3.4	1,381
2052	1,381		3.4	1,384
2053	1,384		3.4	1,387
2054	1,387		3.4	1,390
2055	1,391		3.4	1,394
2056	1,394		3.4	1,397
2057	1,397		3.4	1,400
2058	1,400		3.4	1,403
2059	1,404		3.4	1,407
2060	1,407		3.4	1,410
2061	1,411		3.4	1,414
2062	1,414		3.4	1,417
2063	1,418		3.4	1,421
2064	1,422		3.4	1,425
2065	1,425		3.4	1,428
2066	1,429		3.4	1,432
2067	1,433		3.4	1,436
2068	1,436		3.4	1,439
2069	1,440		3.4	1,443
2070	1,444		3.4	1,447

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	151,443	13.00	111
2016	152,378	13.00	111
2017	153,314	13.00	112
2018	154,250	13.00	113
2019	154,288	13.00	113
2020	154,326	13.00	113
2021	154,365	13.00	113
2022	154,403	13.00	113
2023	154,441	13.00	113
2024	154,881	13.00	113

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - **b.** Savings could be 298 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,375	111	1,487	298	33	56	89	1,695
2017	1,372	112	1,484	298	33	67	100	1,681
2018	1,368	113	1,481	298	40	78	118	1,661
2019	1,364	113	1,477	298	46	89	136	1,639
2020	1,361	113	1,474	298	60	100	160	1,611
2021	1,357	113	1,470	298	71	109	180	1,588
2022	1,357	113	1,470	298	82	118	200	1,568
2023	1,357	113	1,470	298	93	127	220	1,548
2024	1,357	113	1,470	298	104	136	240	1,528
2025	1,358	113	1,472	298	115	146	260	1,509
2026	1,358	114	1,472	298	126	155	280	1,490
2027	1,358	114	1,472	298	137	164	300	1,470
2028	1,358	114	1,473	298	148	173	320	1,450
2029	1,358	115	1,473	298	159	182	340	1,430
2030	1,358	115	1,473	298	170	191	360	1,411
2031	1,358	115	1,474	298	180	199	379	1,393
2032	1,358	116	1,474	298	190	207	397	1,375
2033	1,358	116	1,474	298	200	215	415	1,357
2034	1,358	116	1,475	298	210	224	434	1,339
2035	1,359	117	1,476	298	220	232	452	1,322
2036	1,359	117	1,476	298	230	240	471	1,304
2037	1,359	117	1,477	298	241	248	489	1,286
2038	1,359	118	1,477	298	251	257	507	1,268
2039	1,359	118	1,477	298	261	265	526	1,250
2040	1,359	118	1,478	298	271	273	544	1,232

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[20]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,375	111	1,487	100	33	56	89	1,497
2017	1,372	112	1,484	100	33	67	100	1,484
2018	1,368	113	1,481	100	40	78	118	1,463
2019	1,364	113	1,477	100	46	89	136	1,441
2020	1,361	113	1,474	100	60	100	160	1,413
2021	1,357	113	1,470	100	71	109	180	1,390
2022	1,357	113	1,470	100	82	118	200	1,370
2023	1,357	113	1,470	100	93	127	220	1,350
2024	1,357	113	1,470	100	104	136	240	1,330
2025	1,358	113	1,472	100	115	146	260	1,311
2026	1,358	114	1,472	100	126	155	280	1,292
2027	1,358	114	1,472	100	137	164	300	1,272
2028	1,358	114	1,473	100	148	173	320	1,252
2029	1,358	115	1,473	100	159	182	340	1,232
2030	1,358	115	1,473	100	170	191	360	1,213
2031	1,358	115	1,474	100	180	199	379	1,195
2032	1,358	116	1,474	100	190	207	397	1,177
2033	1,358	116	1,474	100	200	215	415	1,159
2034	1,358	116	1,475	100	210	224	434	1,141
2035	1,359	117	1,476	100	220	232	452	1,124
2036	1,359	117	1,476	100	230	240	471	1,106
2037	1,359	117	1,477	100	241	248	489	1,088
2038	1,359	118	1,477	100	251	257	507	1,070
2039	1,359	118	1,477	100	261	265	526	1,051
2040	1,359	118	1,478	100	271	273	544	1,033

3. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Pearland Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Pearland's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Pearland's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Pearland's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Pearland with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	280	(175)	105	24	29	53	52
2016	724	(179)	545	30	37	67	479
2017	731	(184)	547	30	44	74	473
2018	738	(188)	550	36	51	87	462
2019	744	(192)	552	42	59	101	451
2020	751	(197)	554	54	66	120	434
2021	757	(201)	556	64	73	137	419
2022	764	(206)	558	74	80	154	404
2023	770	(210)	560	84	87	171	389
2024	777	(212)	565	94	94	188	377
2025	783	(214)	570	104	101	205	365
2026	790	(216)	574	115	107	222	352
2027	797	(218)	579	125	114	239	340
2028	803	(219)	584	135	121	256	328
2029	810	(221)	588	145	128	273	315
2030	816	(223)	593	155	135	290	303
2031	825	(225)	600	165	139	304	295
2032	833	(227)	606	175	144	319	287
2033	841	(229)	613	185	148	333	279
2034	849	(231)	619	195	152	348	271
2035	858	(233)	625	205	157	362	263
2036	866	(236)	631	215	161	376	254
2037	874	(238)	636	225	165	391	246
2038	883	(240)	642	235	170	405	237
2039	891	(242)	648	245	174	419	229
2040	899	(245)	654	256	178	434	221
2041	907	(247)	660	265	180	445	215
2042	915	(249)	666	275	181	456	210
2043	924	(252)	672	284	183	467	205
2044	932	(254)	678	294	184	478	200
2045	940	(256)	684	303	186	489	194
2046	948	(259)	689	313	187	500	189
2047	956	(261)	695	322	189	511	184
2048	964	(263)	701	332	191	522	179
2049	972	(265)	707	341	192	533	174
2050	981	(268)	713	351	194	545	168
2051	989	(270)	719	360	195	555	164
2052	997	(272)	725	369	197	566	159
2053	1,005	(275)	731	378	198	576	155
2054	1,014	(277)	737	387	200	587	150
2055	1,022	(279)	743	396	201	597	145
2056	1,030	(281)	749	405	203	608	141
2057	1,038	(284)	755	414	205	618	136
2058	1,047	(286)	761	423	206	629	132
2059	1,055	(288)	767	432	208	640	127
2060	1,063	(291)	772	441	209	650	122
2061	1,071	(293)	778	449	211	660	118
2062	1,079	(295)	783	457	212	669	114
2063	1,086	(298)	789	465	214	679	110
2064	1,094	(300)	794	473	215	689	106
2065	1,102	(302)	800	481	217	698	101
2066	1,109	(304)	805	489	218	708	97
2067	1,117	(306)	811	498	220	717	93
2068	1,125	(308)	816	506	221	727	89
2069	1,133	(311)	822	514	223	737	85
2070	1,140	(313)	827	522	225	746	81

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Pearland's quantified savings from its implemented activities compare with 5- and 10-years goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	117	0	0	0
1	2015	103,013	115	60	105	45
2	2016	105,443	114	123	545	422
3	2017	107,873	112	189	547	358
4	2018	110,304	111	258	550	292
5-year Goal	2019	112,734	109	329	552	222
6	2020	115,164	109	353	554	201
7	2021	116,171	108	373	556	183
8	2022	117,177	108	393	558	165
9	2023	118,184	107	414	560	146
10-year Goal	2024	119,191	107	435	565	130

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Pearland's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	11.00	0	0	0
1	2015	103,013	11.00	0	(175)	(175)
2	2016	105,443	11.00	0	(179)	(179)
3	2017	107,873	11.00	0	(184)	(184)
4	2018	110,304	11.00	0	(188)	(188)
5-year Goal	2019	112,734	11.00	0	(192)	(192)
6	2020	115,164	11.00	0	(197)	(197)
7	2021	116,171	11.00	0	(201)	(201)
8	2022	117,177	11.00	0	(206)	(206)
9	2023	118,184	11.00	0	(210)	(210)
10-year Goal	2024	119,191	11.00	0	(212)	(212)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 175 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 7.8% increase in 2014 (no increase on base)
        ii. 12.2% increase in 2016 (no increase on base)
    b. Estimated customer demand reduction of 2.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	277	277
2015	280	280
2016	724	724
2017	731	731
2018	738	738
2019	744	744
2020	751	751
2021	757	757
2022	764	764
2023	770	770
2024	777	777
2025	783	783
2026	790	790
2027	797	797
2028	803	803
2029	810	810
2030	816	816
2031	825	825
2032	833	833
2033	841	841
2034	849	849
2035	858	858
2036	866	866
2037	874	874
2038	883	883
2039	891	891
2040	899	899
2041	907	907
2042	915	915
2043	924	924
2044	932	932
2045	940	940
2046	948	948
2047	956	956
2048	964	964
2049	972	972
2050	981	981
2051	989	989
2052	997	997
2053	1,005	1,005
2054	1,014	1,014
2055	1,022	1,022
2056	1,030	1,030
2057	1,038	1,038
2058	1,047	1,047
2059	1,055	1,055
2060	1,063	1,063
2061	1,071	1,071
2062	1,079	1,079
2063	1,086	1,086
2064	1,094	1,094
2065	1,102	1,102
2066	1,109	1,109
2067	1,117	1,117
2068	1,125	1,125
2069	1,133	1,133
2070	1,140	1,140

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	11.00	0
2015	95,722	16.00	(175)
2016	98,153	16.00	(179)
2017	100,583	16.00	(184)
2018	103,013	16.00	(188)
2019	105,443	16.00	(192)
2020	107,873	16.00	(197)
2021	110,304	16.00	(201)
2022	112,734	16.00	(206)
2023	115,164	16.00	(210)
2024	116,171	16.00	(212)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 4% savings of total demand Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region H savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 1,449 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	724	(179)	545	1,449	30	37	67	1,927
2017	731	(184)	547	1,462	30	44	74	1,935
2018	738	(188)	550	1,475	36	51	87	1,937
2019	744	(192)	552	1,488	42	59	101	1,939
2020	751	(197)	554	1,501	54	66	120	1,935
2020	757	(201)	556	1,514	64	73	137	1,933
2020	764	(206)	558	1,528	74	80	154	1,932
2020	770	(210)	560	1,541	84	87	171	1,930
2020	777	(212)	565	1,554	94	94	188	1,931
2020	783	(214)	570	1,567	104	101	205	1,932
2020	790	(216)	574	1,580	115	107	222	1,932
2020	797	(218)	579	1,593	125	114	239	1,933
2020	803	(219)	584	1,606	135	121	256	1,934
2020	810	(221)	588	1,619	145	128	273	1,935
2020	816	(223)	593	1,633	155	135	290	1,936
2020	825	(225)	600	1,649	165	139	304	1,944
2020	833	(227)	606	1,666	175	144	319	1,953
2020	841	(229)	613	1,682	185	148	333	1,962
2020	849	(231)	619	1,699	195	152	348	1,970
2020	858	(233)	625	1,715	205	157	362	1,978
2020	866	(236)	631	1,732	215	161	376	1,986
2020	874	(238)	636	1,749	225	165	391	1,994
2020	883	(240)	642	1,765	235	170	405	2,003
2020	891	(242)	648	1,782	245	174	419	2,011
2020	899	(245)	654	1,798	256	178	434	2,019

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	724	(179)	545	485	30	37	67	964
2017	731	(184)	547	490	30	44	74	963
2018	738	(188)	550	494	36	51	87	956
2019	744	(192)	552	499	42	59	101	950
2020	751	(197)	554	503	54	66	120	937
2021	757	(201)	556	507	64	73	137	926
2022	764	(206)	558	512	74	80	154	916
2023	770	(210)	560	516	84	87	171	905
2024	777	(212)	565	521	94	94	188	897
2025	783	(214)	570	525	104	101	205	890
2026	790	(216)	574	529	115	107	222	882
2027	797	(218)	579	534	125	114	239	874
2028	803	(219)	584	538	135	121	256	866
2029	810	(221)	588	542	145	128	273	858
2030	816	(223)	593	547	155	135	290	850
2031	825	(225)	600	552	165	139	304	848
2032	833	(227)	606	558	175	144	319	845
2033	841	(229)	613	564	185	148	333	843
2034	849	(231)	619	569	195	152	348	840
2035	858	(233)	625	575	205	157	362	837
2036	866	(236)	631	580	215	161	376	834
2037	874	(238)	636	586	225	165	391	832
2038	883	(240)	642	591	235	170	405	829
2039	891	(242)	648	597	245	174	419	826
2040	899	(245)	654	602	256	178	434	823

3. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Southern Montgomery County MUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Southern Montgomery County MUD's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Southern Montgomery County MUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Southern Montgomery County MUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Southern Montgomery County MUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	40	40	1	0	1	39
2016	0	40	40	1	0	1	39
2017	0	41	41	1	0	1	40
2018	0	41	41	2	0	2	40
2019	0	42	42	2	0	2	40
2020	0	42	42	2	0	2	40
2021	0	42	42	3	0	3	40
2022	0	43	43	3	0	3	40
2023	0	43	43	3	0	3	40
2024	0	43	43	4	0	4	40
2025	0	44	44	4	0	4	40
2026	0	44	44	4	0	4	40
2027	0	45	45	5	0	5	40
2028	0	45	45	5	0	5	40
2029	0	46	46	6	0	6	40
2030	0	46	46	6	0	6	40
2031	0	46	46	6	0	6	40
2032	0	47	47	6	0	6	41
2033	0	47	47	6	0	6	41
2034	0	47	47	7	0	7	41
2035	0	47	47	7	0	7	40
2036	0	47	47	7	0	7	40
2037	0	47	47	7	0	7	40
2038	0	47	47	7	0	7	40
2039	0	47	47	8	0	8	40
2040	0	48	48	8	0	8	40
2041	0	48	48	8	0	8	39
2042	0	48	48	9	0	9	39
2043	0	48	48	9	0	9	39
2044	0	48	48	9	0	9	38
2045	0	48	48	10	0	10	38
2046	0	48	48	10	0	10	38
2047	0	48	48	11	0	11	37
2048	0	48	48	11	0	11	37
2049	0	48	48	11	0	11	37
2050	0	48	48	12	0	12	36
2051	0	48	48	12	0	12	36
2052	0	48	48	12	0	12	37
2053	0	48	48	12	0	12	37
2054	0	48	48	12	0	12	37
2055	0	49	49	12	0	12	37
2056	0	49	49	12	0	12	37
2057	0	49	49	12	0	12	37
2058	0	49	49	12	0	12	37
2059	0	49	49	12	0	12	37
2060	0	49	49	12	0	12	38
2061	0	49	49	12	0	12	38
2062	0	50	50	12	0	12	38
2063	0	50	50	12	0	12	38
2064	0	50	50	12	0	12	38
2065	0	50	50	12	0	12	38
2066	0	50	50	12	0	12	38
2067	0	50	50	12	0	12	38
2068	0	50	50	12	0	12	38
2069	0	50	50	12	0	12	39
2070	0	50	50	12	0	12	39

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Southern Montgomery County MUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	115	0	0	0
1	2015	11,310	112	12	40	28
2	2016	11,402	109	25	40	15
3	2017	11,493	106	38	41	3
4	2018	11,585	103	51	41	(9)
5-year Goal	2019	11,676	100	64	42	(22)
6	2020	11,768	98	73	42	(31)
7	2021	11,885	96	82	42	(40)
8	2022	12,002	94	92	43	(49)
9	2023	12,120	92	102	43	(59)
10-year Goal	2024	12,237	90	112	43	(68)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Southern Montgomery County MUD's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	11,310	19.00	4	40	36
2	2016	11,402	18.00	8	40	32
3	2017	11,493	17.00	13	41	28
4	2018	11,585	16.00	17	41	24
5-year Goal	2019	11,676	15.00	21	42	20
6	2020	11,768	14.20	25	42	17
7	2021	11,885	13.40	29	42	14
8	2022	12,002	12.60	32	43	10
9	2023	12,120	11.80	36	43	7
10-year Goal	2024	12,237	11.00	40	43	3

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 40 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
      i. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.00	0
2015	10,963	10.00	40
2016	11,078	10.00	40
2017	11,194	10.00	41
2018	11,310	10.00	41
2019	11,402	10.00	42
2020	11,493	10.00	42
2021	11,585	10.00	42
2022	11,676	10.00	43
2023	11,768	10.00	43
2024	11,885	10.00	43

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

      i. Average Region H savings

      ii. Specific percentage of outdoor usage unknown for your utility at this time

   b. Savings could be 11 MG per year with current demand.

   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	40	40	11	1	0	1	50
2017	0	41	41	11	1	0	1	51
2018	0	41	41	11	2	0	2	51
2019	0	42	42	11	2	0	2	51
2020	0	42	42	11	2	0	2	51
2021	0	42	42	11	3	0	3	51
2022	0	43	43	11	3	0	3	51
2023	0	43	43	11	3	0	3	51
2024	0	43	43	11	4	0	4	51
2025	0	44	44	11	4	0	4	51
2026	0	44	44	11	4	0	4	51
2027	0	45	45	11	5	0	5	51
2028	0	45	45	11	5	0	5	51
2029	0	46	46	11	6	0	6	51
2030	0	46	46	11	6	0	6	51
2031	0	46	46	11	6	0	6	52
2032	0	47	47	11	6	0	6	52
2033	0	47	47	11	6	0	6	52
2034	0	47	47	11	7	0	7	52
2035	0	47	47	11	7	0	7	52
2036	0	47	47	11	7	0	7	52
2037	0	47	47	11	7	0	7	51
2038	0	47	47	11	7	0	7	51
2039	0	47	47	11	8	0	8	51
2040	0	48	48	11	8	0	8	51

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	40	40	4	1	0	1	43
2017	0	41	41	4	1	0	1	43
2018	0	41	41	4	2	0	2	44
2019	0	42	42	4	2	0	2	44
2020	0	42	42	4	2	0	2	43
2021	0	42	42	4	3	0	3	43
2022	0	43	43	4	3	0	3	43
2023	0	43	43	4	3	0	3	43
2024	0	43	43	4	4	0	4	43
2025	0	44	44	4	4	0	4	44
2026	0	44	44	4	4	0	4	44
2027	0	45	45	4	5	0	5	44
2028	0	45	45	4	5	0	5	44
2029	0	46	46	4	6	0	6	44
2030	0	46	46	4	6	0	6	44
2031	0	46	46	4	6	0	6	44
2032	0	47	47	4	6	0	6	44
2033	0	47	47	4	6	0	6	45
2034	0	47	47	4	7	0	7	44
2035	0	47	47	4	7	0	7	44
2036	0	47	47	4	7	0	7	44
2037	0	47	47	4	7	0	7	44
2038	0	47	47	4	7	0	7	44
2039	0	47	47	4	8	0	8	44
2040	0	48	48	4	8	0	8	43

3. Water Rate Increase
  a. For every 10% increase, estimated savings could be 2% of utility total demand.
  b. Approximately 6 MG of savings per year with current demand
  c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
  d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	40	40	6	1	0	1	45
2017	0	41	41	6	1	0	1	45
2018	0	41	41	6	2	0	2	45
2019	0	42	42	6	2	0	2	45
2020	0	42	42	6	2	0	2	45
2021	0	42	42	6	3	0	3	45
2022	0	43	43	6	3	0	3	45
2023	0	43	43	6	3	0	3	45
2024	0	43	43	6	4	0	4	45
2025	0	44	44	6	4	0	4	45
2026	0	44	44	6	4	0	4	45
2027	0	45	45	6	5	0	5	46
2028	0	45	45	6	5	0	5	46
2029	0	46	46	6	6	0	6	46
2030	0	46	46	6	6	0	6	46
2031	0	46	46	6	6	0	6	46
2032	0	47	47	6	6	0	6	46
2033	0	47	47	6	6	0	6	46
2034	0	47	47	6	7	0	7	46
2035	0	47	47	6	7	0	7	46
2036	0	47	47	6	7	0	7	46
2037	0	47	47	6	7	0	7	46
2038	0	47	47	6	7	0	7	46
2039	0	47	47	6	8	0	8	45
2040	0	48	48	6	8	0	8	45

4. Rain Barrels

  a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

  b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Fort Bend County WCID #2 Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Fort Bend County WCID #2's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Fort Bend County WCID #2's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Fort Bend County WCID #2's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Fort Bend County WCID #2 with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	54	0	54	4	0	4	51
2016	56	0	56	5	0	5	51
2017	54	0	54	5	0	5	49
2018	53	0	53	5	0	5	47
2019	51	0	51	6	0	6	45
2020	49	0	49	8	0	8	41
2021	48	0	48	9	0	9	39
2022	48	0	48	10	0	10	38
2023	48	0	48	12	0	12	36
2024	48	0	48	13	0	13	35
2025	48	0	48	14	0	14	34
2026	48	0	48	15	0	15	33
2027	48	0	48	16	0	16	32
2028	48	0	48	17	0	17	31
2029	48	0	48	18	0	18	30
2030	48	0	48	20	0	20	28
2031	49	0	49	20	0	20	29
2032	49	0	49	21	0	21	28
2033	49	0	49	22	0	22	27
2034	49	0	49	23	0	23	26
2035	49	0	49	24	0	24	25
2036	49	0	49	25	0	25	24
2037	49	0	49	26	0	26	23
2038	49	0	49	27	0	27	22
2039	49	0	49	28	0	28	21
2040	49	0	49	29	0	29	20
2041	50	0	50	30	0	30	20
2042	50	0	50	31	0	31	19
2043	50	0	50	32	0	32	18
2044	50	0	50	33	0	33	17
2045	50	0	50	33	0	33	17
2046	50	0	50	34	0	34	16
2047	50	0	50	35	0	35	15
2048	51	0	51	36	0	36	15
2049	51	0	51	37	0	37	14
2050	51	0	51	38	0	38	13
2051	51	0	51	39	0	39	12
2052	51	0	51	39	0	39	12
2053	51	0	51	40	0	40	11
2054	52	0	52	41	0	41	11
2055	52	0	52	42	0	42	10
2056	52	0	52	42	0	42	10
2057	52	0	52	43	0	43	9
2058	52	0	52	44	0	44	8
2059	53	0	53	45	0	45	8
2060	53	0	53	46	0	46	7
2061	53	0	53	46	0	46	7
2062	53	0	53	47	0	47	6
2063	53	0	53	48	0	48	5
2064	54	0	54	49	0	49	5
2065	54	0	54	50	0	50	4
2066	54	0	54	50	0	50	4
2067	54	0	54	51	0	51	3
2068	55	0	55	52	0	52	3
2069	55	0	55	53	0	53	2
2070	55	0	55	53	0	53	2

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Fort Bend County WCID #2's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	140	0	0	0
1	2015	17,880	140	0	54	54
2	2016	17,918	140	0	56	56
3	2017	17,956	140	0	54	54
4	2018	17,995	140	0	53	53
5-year Goal	2019	18,033	140	0	51	51
6	2020	18,071	144	(26)	49	76
7	2021	18,121	148	(53)	48	101
8	2022	18,172	152	(80)	48	128
9	2023	18,222	156	(106)	48	154
10-year Goal	2024	18,272	160	(133)	48	181

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Fort Bend County WCID #2's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2015	17,880	17.00	0	0	0
2	2016	17,918	17.00	0	0	0
3	2017	17,956	17.00	0	0	0
4	2018	17,995	17.00	0	0	0
5-year Goal	2019	18,033	17.00	0	0	0
6	2,020	18,071	17	(3)	0	3
7	2,021	18,121	18	(5)	0	5
8	2,022	18,172	18	(8)	0	8
9	2,023	18,222	19	(11)	0	11
10-year Goal	2,024	18,272	19	(13)	0	13

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 7.0% increase in 2013
        ii. 10.0% increase in 2015
    b. Estimated customer demand reduction of 3.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. WaterWise Take-home Kits

a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
b. Conservative 5-year useful life for all items in kit
    i. 15% adoption rate assumed

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	WaterWise Take-home Kits	TOTAL SAVINGS
2009		1.5	1
2010		2.7	3
2011		4.0	4
2012		5.6	6
2013	19	7.1	26
2014	20	7.2	27
2015	47	7.4	54
2016	48	7.5	56
2017	48	6.0	54
2018	48	4.5	53
2019	48	2.9	51
2020	48	1.4	49
2021	48		48
2022	48		48
2023	48		48
2024	48		48
2025	48		48
2026	48		48
2027	48		48
2028	48		48
2029	48		48
2030	48		48
2031	49		49
2032	49		49
2033	49		49
2034	49		49
2035	49		49
2036	49		49
2037	49		49
2038	49		49
2039	49		49
2040	49		49
2041	50		50
2042	50		50
2043	50		50
2044	50		50
2045	50		50
2046	50		50
2047	50		50
2048	51		51
2049	51		51
2050	51		51
2051	51		51
2052	51		51
2053	51		51
2054	52		52
2055	52		52
2056	52		52
2057	52		52
2058	52		52
2059	53		53
2060	53		53
2061	53		53
2062	53		53
2063	53		53
2064	54		54
2065	54		54
2066	54		54
2067	54		54
2068	55		55
2069	55		55
2070	55		55

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	17,809	17.00	0
2016	17,833	17.00	0
2017	17,856	17.00	0
2018	17,880	17.00	0
2019	17,918	17.00	0
2020	17,956	17.00	0
2021	17,995	17.00	0
2022	18,033	17.00	0
2023	18,071	17.00	0
2024	18,121	17.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region H savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 56 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	56	0	56	56	5	0	5	107
2017	54	0	54	56	5	0	5	105
2018	53	0	53	56	5	0	5	103
2019	51	0	51	56	6	0	6	101
2020	49	0	49	56	8	0	8	98
2021	48	0	48	56	9	0	9	95
2022	48	0	48	56	10	0	10	94
2023	48	0	48	56	12	0	12	93
2024	48	0	48	57	13	0	13	92
2025	48	0	48	57	14	0	14	91
2026	48	0	48	57	15	0	15	90
2027	48	0	48	57	16	0	16	89
2028	48	0	48	57	17	0	17	88
2029	48	0	48	57	18	0	18	86
2030	48	0	48	57	20	0	20	85
2031	49	0	49	57	20	0	20	86
2032	49	0	49	57	21	0	21	85
2033	49	0	49	57	22	0	22	84
2034	49	0	49	57	23	0	23	83
2035	49	0	49	58	24	0	24	82
2036	49	0	49	58	25	0	25	81
2037	49	0	49	58	26	0	26	81
2038	49	0	49	58	27	0	27	80
2039	49	0	49	58	28	0	28	79
2040	49	0	49	58	29	0	29	78

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	56	0	56	19	5	0	5	70
2017	54	0	54	19	5	0	5	68
2018	53	0	53	19	5	0	5	66
2019	51	0	51	19	6	0	6	63
2020	49	0	49	19	8	0	8	60
2021	48	0	48	19	9	0	9	58
2022	48	0	48	19	10	0	10	56
2023	48	0	48	19	12	0	12	55
2024	48	0	48	19	13	0	13	54
2025	48	0	48	19	14	0	14	53
2026	48	0	48	19	15	0	15	52
2027	48	0	48	19	16	0	16	51
2028	48	0	48	19	17	0	17	50
2029	48	0	48	19	18	0	18	49
2030	48	0	48	19	20	0	20	48
2031	49	0	49	19	20	0	20	48
2032	49	0	49	19	21	0	21	47
2033	49	0	49	19	22	0	22	46
2034	49	0	49	19	23	0	23	45
2035	49	0	49	19	24	0	24	44
2036	49	0	49	19	25	0	25	43
2037	49	0	49	19	26	0	26	42
2038	49	0	49	19	27	0	27	41
2039	49	0	49	19	28	0	28	40
2040	49	0	49	19	29	0	29	39

3. Rain Barrels
   a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Sugarland Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sugarland's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Sugarland's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sugarland's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sugarland with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	47	(30)	16	23	8	31	(15)
2016	47	(31)	16	28	10	39	(23)
2017	37	(32)	5	28	12	41	(36)
2018	27	(32)	(5)	34	14	49	(53)
2019	17	(33)	(16)	40	17	56	(72)
2020	9	(35)	(26)	51	19	70	(96)
2021	0	(36)	(36)	59	19	78	(114)
2022	0	(37)	(37)	68	19	87	(124)
2023	0	(39)	(39)	76	19	95	(133)
2024	0	(39)	(39)	84	19	103	(142)
2025	0	(39)	(39)	93	19	112	(151)
2026	0	(40)	(40)	101	19	120	(160)
2027	0	(40)	(40)	109	19	129	(168)
2028	0	(40)	(40)	117	20	137	(177)
2029	0	(41)	(41)	126	20	145	(186)
2030	0	(41)	(41)	134	20	154	(195)
2031	0	(41)	(41)	141	20	161	(202)
2032	0	(42)	(42)	148	20	168	(210)
2033	0	(42)	(42)	155	20	176	(218)
2034	0	(42)	(42)	163	20	183	(225)
2035	0	(42)	(42)	170	20	190	(233)
2036	0	(43)	(43)	177	20	197	(240)
2037	0	(43)	(43)	184	21	205	(248)
2038	0	(43)	(43)	191	21	212	(255)
2039	0	(44)	(44)	198	21	219	(263)
2040	0	(44)	(44)	206	21	227	(270)
2041	0	(44)	(44)	212	21	233	(277)
2042	0	(44)	(44)	219	21	240	(284)
2043	0	(45)	(45)	226	21	247	(291)
2044	0	(45)	(45)	232	21	254	(298)
2045	0	(45)	(45)	239	22	260	(306)
2046	0	(45)	(45)	246	22	267	(313)
2047	0	(46)	(46)	252	22	274	(320)
2048	0	(46)	(46)	259	22	281	(327)
2049	0	(46)	(46)	265	22	288	(334)
2050	0	(46)	(46)	272	22	294	(341)
2051	0	(47)	(47)	278	22	300	(347)
2052	0	(47)	(47)	284	22	307	(354)
2053	0	(47)	(47)	290	22	313	(360)
2054	0	(47)	(47)	297	23	319	(366)
2055	0	(48)	(48)	303	23	325	(373)
2056	0	(48)	(48)	309	23	331	(379)
2057	0	(48)	(48)	315	23	338	(386)
2058	0	(48)	(48)	321	23	344	(392)
2059	0	(48)	(48)	327	23	350	(399)
2060	0	(49)	(49)	333	23	356	(405)
2061	0	(49)	(49)	338	23	361	(410)
2062	0	(49)	(49)	343	23	367	(416)
2063	0	(49)	(49)	349	23	372	(421)
2064	0	(50)	(50)	354	23	377	(427)
2065	0	(50)	(50)	359	23	383	(432)
2066	0	(50)	(50)	364	24	388	(438)
2067	0	(50)	(50)	370	24	393	(443)
2068	0	(50)	(50)	375	24	398	(449)
2069	0	(50)	(50)	380	24	404	(454)
2070	0	(50)	(50)	385	24	409	(459)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sugarland's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	187	0	0	0
1	2015	88,156	187	13	16	3
2	2016	91,627	186	27	16	(11)
3	2017	95,098	186	42	5	(36)
4	2018	98,568	185	58	(5)	(62)
5-year Goal	2019	102,039	185	74	(16)	(91)
6	2020	105,510	185	92	(26)	(119)
7	2021	106,450	184	109	(36)	(145)
8	2022	107,390	184	125	(37)	(163)
9	2023	108,329	183	142	(39)	(181)
10-year Goal	2024	109,269	183	160	(39)	(198)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sugarland's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	88,156	17.80	6	(30)	(37)
2	2016	91,627	17.60	13	(31)	(44)
3	2017	95,098	17.40	21	(32)	(52)
4	2018	98,568	17.20	29	(32)	(61)
5-year Goal	2019	102,039	17.00	37	(33)	(71)
6	2020	105,510	16.80	46	(35)	(81)
7	2021	106,450	16.60	54	(36)	(90)
8	2022	107,390	16.40	63	(37)	(100)
9	2023	108,329	16.20	71	(39)	(110)
10-year Goal	2024	109,269	16.00	80	(39)	(119)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 30 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Outdoor landscape evaluations for single family (SF) customers**
    a. 700 outdoor evaluations performed since 2011
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
        i. 15% adoption rate assumed

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	W.I.S.E. Guys Outdoor Landscape Evaluations (SF)	WaterWise Take-home Kits	TOTAL SAVINGS
2009		8.7	8.7
2010		15.8	15.8
2011	0.53	23.6	24.2
2012	0.81	32.7	33.5
2013	2.90	41.3	44.2
2014	3.35	42.0	45.3
2015	3.21	43.3	46.5
2016	2.59	44.0	46.5
2017	1.85	34.9	36.7
2018	0.92	26.3	27.2
2019	0.43	16.9	17.3
2020	0.17	8.4	8.6
2021	0.05		0
2022			0
2023			0
2024			0
2025			0
2026			0
2027			0
2028			0
2029			0
2030			0
2031			0
2032			0
2033			0
2034			0
2035			0
2036			0
2037			0
2038			0
2039			0
2040			0
2041			0
2042			0
2043			0
2044			0
2045			0
2046			0
2047			0
2048			0
2049			0
2050			0
2051			0
2052			0
2053			0
2054			0
2055			0
2056			0
2057			0
2058			0
2059			0
2060			0
2061			0
2062			0
2063			0
2064			0
2065			0
2066			0
2067			0
2068			0
2069			0
2070			0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	82,728	19.00	(30)
2016	84,537	19.00	(31)
2017	86,347	19.00	(32)
2018	88,156	19.00	(32)
2019	91,627	19.00	(33)
2020	95,098	19.00	(35)
2021	98,568	19.00	(36)
2022	102,039	19.00	(37)
2023	105,510	19.00	(39)
2024	106,450	19.00	(39)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 6.95% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - **b.** Savings could be 618 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	47	(31)	16	618	28	10	39	595
2017	37	(32)	5	623	28	12	41	588
2018	27	(32)	(5)	628	34	14	49	575
2019	17	(33)	(16)	633	40	17	56	561
2020	9	(35)	(26)	638	51	19	70	542
2021	0	(36)	(36)	643	59	19	78	529
2022	0	(37)	(37)	648	68	19	87	524
2023	0	(39)	(39)	653	76	19	95	519
2024	0	(39)	(39)	658	84	19	103	516
2025	0	(39)	(39)	663	93	19	112	512
2026	0	(40)	(40)	668	101	19	120	508
2027	0	(40)	(40)	673	109	19	129	504
2028	0	(40)	(40)	678	117	20	137	500
2029	0	(41)	(41)	682	126	20	145	496
2030	0	(41)	(41)	687	134	20	154	493
2031	0	(41)	(41)	691	141	20	161	489
2032	0	(42)	(42)	695	148	20	168	485
2033	0	(42)	(42)	699	155	20	176	481
2034	0	(42)	(42)	703	163	20	183	478
2035	0	(42)	(42)	707	170	20	190	474
2036	0	(43)	(43)	710	177	20	197	470
2037	0	(43)	(43)	714	184	21	205	467
2038	0	(43)	(43)	718	191	21	212	463
2039	0	(44)	(44)	722	198	21	219	459
2040	0	(44)	(44)	726	206	21	227	456

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	47	(31)	16	119	28	10	39	96
2017	37	(32)	5	120	28	12	41	85
2018	27	(32)	(5)	121	34	14	49	68
2019	17	(33)	(16)	122	40	17	56	50
2020	9	(35)	(26)	123	51	19	70	27
2021	0	(36)	(36)	124	59	19	78	10
2022	0	(37)	(37)	125	68	19	87	1
2023	0	(39)	(39)	126	76	19	95	(8)
2024	0	(39)	(39)	127	84	19	103	(15)
2025	0	(39)	(39)	128	93	19	112	(23)
2026	0	(40)	(40)	129	101	19	120	(31)
2027	0	(40)	(40)	130	109	19	129	(39)
2028	0	(40)	(40)	131	117	20	137	(47)
2029	0	(41)	(41)	132	126	20	145	(54)
2030	0	(41)	(41)	133	134	20	154	(62)
2031	0	(41)	(41)	133	141	20	161	(69)
2032	0	(42)	(42)	134	148	20	168	(76)
2033	0	(42)	(42)	135	155	20	176	(83)
2034	0	(42)	(42)	135	163	20	183	(90)
2035	0	(42)	(42)	136	170	20	190	(96)
2036	0	(43)	(43)	137	177	20	197	(103)
2037	0	(43)	(43)	138	184	21	205	(110)
2038	0	(43)	(43)	138	191	21	212	(117)
2039	0	(44)	(44)	139	198	21	219	(124)
2040	0	(44)	(44)	140	206	21	227	(130)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 178 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	47	(31)	16	178	28	10	39	155
2017	37	(32)	5	179	28	12	41	144
2018	27	(32)	(5)	181	34	14	49	127
2019	17	(33)	(16)	182	40	17	56	110
2020	9	(35)	(26)	184	51	19	70	88
2021	0	(36)	(36)	185	59	19	78	71
2022	0	(37)	(37)	186	68	19	87	63
2023	0	(39)	(39)	188	76	19	95	54
2024	0	(39)	(39)	189	84	19	103	47
2025	0	(39)	(39)	191	93	19	112	40
2026	0	(40)	(40)	192	101	19	120	32
2027	0	(40)	(40)	194	109	19	129	25
2028	0	(40)	(40)	195	117	20	137	18
2029	0	(41)	(41)	196	126	20	145	10
2030	0	(41)	(41)	198	134	20	154	3
2031	0	(41)	(41)	199	141	20	161	(3)
2032	0	(42)	(42)	200	148	20	168	(10)
2033	0	(42)	(42)	201	155	20	176	(16)
2034	0	(42)	(42)	202	163	20	183	(23)
2035	0	(42)	(42)	203	170	20	190	(29)
2036	0	(43)	(43)	204	177	20	197	(36)
2037	0	(43)	(43)	206	184	21	205	(42)
2038	0	(43)	(43)	207	191	21	212	(49)
2039	0	(44)	(44)	208	198	21	219	(55)
2040	0	(44)	(44)	209	206	21	227	(61)

4. Rain Barrels

a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
The Woodlands Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares The Woodlands' current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) The Woodlands' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in The Woodlands' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for The Woodlands with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1,193	508	1,702	34	0	34	1,668
2016	1,378	520	1,898	42	0	42	1,855
2017	1,381	529	1,910	42	0	42	1,867
2018	1,385	538	1,923	51	0	51	1,872
2019	1,390	552	1,942	59	0	59	1,883
2020	1,395	567	1,962	76	0	76	1,886
2021	1,401	582	1,983	88	0	88	1,894
2022	1,408	596	2,004	101	0	101	1,904
2023	1,415	611	2,026	113	0	113	1,913
2024	1,422	615	2,037	125	0	125	1,911
2025	1,429	618	2,047	137	0	137	1,910
2026	1,436	622	2,058	150	0	150	1,908
2027	1,443	626	2,069	162	0	162	1,907
2028	1,450	630	2,080	174	0	174	1,906
2029	1,457	634	2,090	186	0	186	1,904
2030	1,464	638	2,101	198	0	198	1,903
2031	1,472	641	2,113	208	0	208	1,905
2032	1,480	645	2,125	217	0	217	1,907
2033	1,487	649	2,136	227	0	227	1,909
2034	1,495	653	2,148	236	0	236	1,912
2035	1,503	657	2,160	246	0	246	1,914
2036	1,511	661	2,172	255	0	255	1,916
2037	1,519	665	2,183	265	0	265	1,919
2038	1,526	669	2,195	274	0	274	1,921
2039	1,534	672	2,207	284	0	284	1,923
2040	1,542	676	2,219	293	0	293	1,926
2041	1,551	680	2,231	309	0	309	1,923
2042	1,560	684	2,244	324	0	324	1,920
2043	1,569	688	2,257	340	0	340	1,917
2044	1,578	692	2,270	356	0	356	1,914
2045	1,586	697	2,283	372	0	372	1,912
2046	1,595	701	2,296	387	0	387	1,909
2047	1,604	705	2,309	403	0	403	1,906
2048	1,613	709	2,322	419	0	419	1,904
2049	1,622	714	2,336	434	0	434	1,901
2050	1,631	718	2,349	450	0	450	1,899
2051	1,643	722	2,365	455	0	455	1,910
2052	1,656	726	2,382	460	0	460	1,922
2053	1,668	731	2,399	465	0	465	1,933
2054	1,681	736	2,417	470	0	470	1,947
2055	1,693	742	2,435	475	0	475	1,960
2056	1,706	748	2,453	480	0	480	1,973
2057	1,718	753	2,471	485	0	485	1,986
2058	1,730	759	2,489	490	0	490	1,999
2059	1,743	765	2,508	496	0	496	2,012
2060	1,755	770	2,526	501	0	501	2,025
2061	1,770	776	2,546	505	0	505	2,041
2062	1,785	782	2,567	509	0	509	2,057
2063	1,800	787	2,587	514	0	514	2,074
2064	1,815	794	2,609	518	0	518	2,091
2065	1,829	801	2,630	522	0	522	2,108
2066	1,844	807	2,652	527	0	527	2,125
2067	1,859	814	2,673	531	0	531	2,142
2068	1,874	821	2,695	536	0	536	2,159
2069	1,889	828	2,716	540	0	540	2,176
2070	1,903	834	2,738	544	0	544	2,193

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how The Woodlands quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	194	0	0	0
1	2015	102,250	193	63	1,702	1,639
2	2016	105,029	191	129	1,898	1,769
3	2017	107,809	189	198	1,910	1,711
4	2018	110,588	188	271	1,923	1,651
5-year Goal	2019	113,368	186	348	1,942	1,594
6	2020	116,147	184	432	1,962	1,530
7	2021	116,870	182	512	1,983	1,471
8	2022	117,593	181	592	2,004	1,412
9	2023	118,316	179	674	2,026	1,352
10-year Goal	2024	119,039	177	756	2,037	1,281

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how The Woodlands' most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	102,250	17.80	7	508	501
2	2016	105,029	17.60	15	520	505
3	2017	107,809	17.40	24	529	505
4	2018	110,588	17.20	32	538	506
5-year Goal	2019	113,368	17.00	41	552	511
6	2020	116,147	16.80	51	567	516
7	2021	116,870	16.60	60	582	522
8	2022	117,593	16.40	69	596	528
9	2023	118,316	16.20	78	611	533
10-year Goal	2024	119,039	16.00	87	615	528

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 508 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10% increase in 2014
        ii. 10% increase in 2016
    b. Estimated customer demand reduction of 4.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999).
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 8.84% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. **W.I.S.E. Guys Evaluations**
    a. 3,390 outdoor evaluations performed since 2010
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. **Rain Barrels**
    a. 1,000 50-gallon barrels distributed from 2012 – 2016
    b. Approximately 200 barrels per year
    c. In Region H, estimated savings of 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002)
    d. Estimated 10-year useful life for most barrels

9. **PARDES Campus Rainwater Harvesting**
    a. Estimated savings of 26.8 gallons per year per gallon of capacity
    b. Estimated 10-year useful life
        i. 2,500-gallon system

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increases	2x Watering Ordinance	W.I.S.E. Guys Outdoor Landscape Evaluations (SF)	Rain Barrels	PARDES Campus Rainwater Harvesting	TOTAL SAVINGS
2009	214						214
2010	215			3.8			219
2011	217			6.9			223
2012	218			9.2	0.3	0.1	227
2013	219		774	10.7	0.5	0.1	1,004
2014	220	176	778	11.5	0.8	0.1	1,186
2015	221	177	782	11.6	1.1	0.1	1,193
2016	222	356	786	11.8	1.3	0.1	1,378
2017	224	358	790	7.9	1.3	0.1	1,381
2018	225	359	794	4.8	1.3	0.1	1,385
2019	226	361	799	2.4	1.3	0.1	1,390
2020	227	363	803	0.8	1.3	0.1	1,395
2021	228	365	807		1.3	0.1	1,401
2022	229	367	811		1.1	0.1	1,408
2023	230	369	815		0.8	0.1	1,415
2024	232	371	819		0.5	0.1	1,422
2025	233	372	823		0.3	0.1	1,429
2026	234	374	827			0.1	1,436
2027	235	376	831				1,443
2028	236	378	835				1,450
2029	237	380	840				1,457
2030	239	382	844				1,464
2031	240	384	848				1,472
2032	241	386	853				1,480
2033	242	388	857				1,487
2034	244	390	862				1,495
2035	245	392	866				1,503
2036	246	394	871				1,511
2037	247	396	875				1,519
2038	249	398	880				1,526
2039	250	400	884				1,534
2040	251	402	889				1,542
2041	253	404	894				1,551
2042	254	407	899				1,560
2043	256	409	904				1,569
2044	257	411	909				1,578
2045	259	414	914				1,586
2046	260	416	919				1,595
2047	261	418	924				1,604
2048	263	421	930				1,613
2049	264	423	935				1,622
2050	266	425	940				1,631
2051	268	428	947				1,643
2052	270	432	954				1,656
2053	272	435	961				1,668
2054	274	438	968				1,681
2055	276	441	976				1,693
2056	278	445	983				1,706
2057	280	448	990				1,718
2058	282	451	997				1,730
2059	284	454	1,004				1,743
2060	286	458	1,012				1,755
2061	288	462	1,020				1,770
2062	291	465	1,029				1,785
2063	293	469	1,037				1,800
2064	296	473	1,046				1,815
2065	298	477	1,054				1,829
2066	301	481	1,063				1,844
2067	303	485	1,071				1,859
2068	305	489	1,080				1,874
2069	308	492	1,088				1,889
2070	310	496	1,097				1,903

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	97,208	3.67	508
2016	98,889	3.59	520
2017	100,569	3.59	529
2018	102,250	3.59	538
2019	105,029	3.59	552
2020	107,809	3.59	567
2021	110,588	3.59	582
2022	113,368	3.59	596
2023	116,147	3.59	611
2024	116,870	3.59	615

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,378	520	1,898	119	42	0	42	1,975
2017	1,381	529	1,910	120	42	0	42	1,987
2018	1,385	538	1,923	120	51	0	51	1,992
2019	1,390	552	1,942	121	59	0	59	2,004
2020	1,395	567	1,962	122	76	0	76	2,007
2021	1,401	582	1,983	122	88	0	88	2,017
2022	1,408	596	2,004	123	101	0	101	2,027
2023	1,415	611	2,026	124	113	0	113	2,037
2024	1,422	615	2,037	124	125	0	125	2,036
2025	1,429	618	2,047	125	137	0	137	2,035
2026	1,436	622	2,058	125	150	0	150	2,034
2027	1,443	626	2,069	126	162	0	162	2,033
2028	1,450	630	2,080	127	174	0	174	2,032
2029	1,457	634	2,090	127	186	0	186	2,032
2030	1,464	638	2,101	128	198	0	198	2,031
2031	1,472	641	2,113	129	208	0	208	2,034
2032	1,480	645	2,125	129	217	0	217	2,037
2033	1,487	649	2,136	130	227	0	227	2,039
2034	1,495	653	2,148	131	236	0	236	2,042
2035	1,503	657	2,160	131	246	0	246	2,045
2036	1,511	661	2,172	132	255	0	255	2,048
2037	1,519	665	2,183	133	265	0	265	2,051
2038	1,526	669	2,195	133	274	0	274	2,054
2039	1,534	672	2,207	134	284	0	284	2,057
2040	1,542	676	2,219	135	293	0	293	2,060

Statewide Water Conservation Quantification Project
City of West University Place Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares West University Place's current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) West University Place's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in West University Place's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for West University Place with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4.3	78	82	3	5	8	74
2016	5.2	62	67	4	6	10	57
2017	4.9	62	67	4	7	12	56
2018	4.6	63	68	5	9	14	54
2019	4.2	63	68	6	10	16	52
2020	3.9	64	67	7	11	19	49
2021	3.6	64	67	9	12	21	46
2022	3.6	64	68	10	13	24	44
2023	3.6	64	68	12	14	26	41
2024	3.6	64	68	13	16	29	39
2025	3.7	64	68	15	17	32	36
2026	3.7	64	68	16	18	34	34
2027	3.7	64	68	18	19	37	31
2028	3.7	64	68	19	20	39	29
2029	3.7	65	68	21	21	42	26
2030	3.8	65	68	22	22	45	24
2031	3.8	65	68	24	22	46	22
2032	3.8	65	68	26	23	48	20
2033	3.8	65	69	27	23	50	19
2034	3.8	65	69	29	23	52	17
2035	3.9	66	70	30	23	54	16
2036	3.9	66	70	32	24	55	15
2037	3.9	67	71	33	24	57	13
2038	3.9	67	71	35	24	59	12
2039	3.9	68	72	36	25	61	11
2040	4.0	68	72	38	25	63	10
2041	4.0	69	73	39	25	64	8
2042	4.0	69	73	41	25	66	7
2043	4.0	70	74	43	25	68	6
2044	4.1	70	74	44	25	70	5
2045	4.1	71	75	46	26	72	3
2046	4.1	71	76	48	26	73	2
2047	4.2	72	76	49	26	75	1
2048	4.2	72	77	51	26	77	-0
2049	4.2	73	77	52	26	79	-1
2050	4.2	74	78	54	26	80	(3)
2051	4.3	74	78	56	27	82	(4)
2052	4.3	75	79	57	27	84	(5)
2053	4.3	75	80	59	27	86	(7)
2054	4.4	76	80	61	27	88	(8)
2055	4.4	76	81	63	27	90	(9)
2056	4.4	77	81	64	28	92	(10)
2057	4.5	78	82	66	28	94	(12)
2058	4.5	78	83	68	28	96	(13)
2059	4.5	79	83	69	28	98	(14)
2060	4.5	79	84	71	28	99	(16)
2061	4.6	80	84	73	29	101	(17)
2062	4.6	80	85	75	29	103	(18)
2063	4.7	81	86	76	29	105	(20)
2064	4.7	82	86	78	29	107	(21)
2065	4.7	82	87	80	29	109	(22)
2066	4.8	83	88	82	30	111	(24)
2067	4.8	84	88	83	30	113	(25)
2068	4.8	84	89	85	30	115	(26)
2069	4.9	85	90	87	30	117	(28)
2070	4.9	85	90	89	31	119	(29)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how West University Place's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	152	0	0	0
1	2015	15,710	149	19	82	62
2	2016	15,767	145	39	67	28
3	2017	15,824	142	59	67	8
4	2018	15,881	138	79	68	(11)
5-year Goal	2019	15,938	135	99	68	(31)
6	2020	15,995	134	105	67	(38)
7	2021	16,008	133	111	67	(44)
8	2022	16,021	132	117	68	(49)
9	2023	16,033	131	123	68	(55)
10-year Goal	2024	16,046	130	129	68	(61)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how West University Place's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	15,710	14.70	2	78	76
2	2016	15,767	14.40	3	62	58
3	2017	15,824	14.10	5	62	57
4	2018	15,881	13.80	7	63	56
5-year Goal	2019	15,938	13.50	9	63	55
6	2020	15,995	12.10	17	64	47
7	2021	16,008	10.70	25	64	39
8	2022	16,021	9.30	33	64	31
9	2023	16,033	7.90	42	64	23
10-year Goal	2024	16,046	6.50	50	64	14

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 78 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 1.4% increase in 2015
        ii. .05% increase in 2016
    b. Estimated customer demand reduction of .38%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	WaterWise Take-home Kits	TOTAL SAVINGS
2009		0.4	0.4
2010		0.7	0.7
2011		1.0	1.0
2012		1.3	1.3
2013		1.7	1.7
2014		1.7	1.7
2015	3	1.7	4.3
2016	4	1.7	5.2
2017	4	1.4	4.9
2018	4	1.1	4.6
2019	4	0.7	4.2
2020	4	0.3	3.9
2021	4		3.6
2022	4		3.6
2023	4		3.6
2024	4		3.6
2025	4		3.7
2026	4		3.7
2027	4		3.7
2028	4		3.7
2029	4		3.7
2030	4		3.8
2031	4		3.8
2032	4		3.8
2033	4		3.8
2034	4		3.8
2035	4		3.9
2036	4		3.9
2037	4		3.9
2038	4		3.9
2039	4		3.9
2040	4		4.0
2041	4		4.0
2042	4		4.0
2043	4		4.0
2044	4		4.1
2045	4		4.1
2046	4		4.1
2047	4		4.2
2048	4		4.2
2049	4		4.2
2050	4		4.2
2051	4		4.3
2052	4		4.3
2053	4		4.3
2054	4		4.4
2055	4		4.4
2056	4		4.4
2057	4		4.5
2058	4		4.5
2059	5		4.5
2060	5		4.5
2061	5		4.6
2062	5		4.6
2063	5		4.7
2064	5		4.7
2065	5		4.7
2066	5		4.8
2067	5		4.8
2068	5		4.8
2069	5		4.9
2070	5		4.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	15,177	1.00	78
2016	15,354	4.00	62
2017	15,532	4.00	62
2018	15,710	4.00	63
2019	15,767	4.00	63
2020	15,824	4.00	64
2021	15,881	4.00	64
2022	15,938	4.00	64
2023	15,995	4.00	64
2024	16,008	4.00	64

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region H savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 37 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	62	67	37	4	6	10	93
2017	5	62	67	37	4	7	12	93
2018	5	63	68	37	5	9	14	91
2019	4	63	68	37	6	10	16	89
2020	4	64	67	38	7	11	19	86
2021	4	64	67	38	9	12	21	84
2022	4	64	68	38	10	13	24	82
2023	4	64	68	38	12	14	26	80
2024	4	64	68	38	13	16	29	77
2025	4	64	68	39	15	17	32	75
2026	4	64	68	39	16	18	34	73
2027	4	64	68	39	18	19	37	70
2028	4	64	68	39	19	20	39	68
2029	4	65	68	39	21	21	42	66
2030	4	65	68	39	22	22	45	63
2031	4	65	68	40	24	22	46	62
2032	4	65	68	40	26	23	48	60
2033	4	65	69	40	27	23	50	59
2034	4	65	69	40	29	23	52	58
2035	4	66	70	41	30	23	54	57
2036	4	66	70	41	32	24	55	56
2037	4	67	71	41	33	24	57	55
2038	4	67	71	41	35	24	59	53
2039	4	68	72	42	36	25	61	52
2040	4	68	72	42	38	25	63	51

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	5	62	67	12	4	6	10	69
2017	5	62	67	12	4	7	12	68
2018	5	63	68	12	5	9	14	67
2019	4	63	68	13	6	10	16	64
2020	4	64	67	13	7	11	19	61
2021	4	64	67	13	9	12	21	59
2022	4	64	68	13	10	13	24	57
2023	4	64	68	13	12	14	26	54
2024	4	64	68	13	13	16	29	52
2025	4	64	68	13	15	17	32	49
2026	4	64	68	13	16	18	34	47
2027	4	64	68	13	18	19	37	44
2028	4	64	68	13	19	20	39	42
2029	4	65	68	13	21	21	42	39
2030	4	65	68	13	22	22	45	37
2031	4	65	68	13	24	22	46	35
2032	4	65	68	13	26	23	48	34
2033	4	65	69	13	27	23	50	32
2034	4	65	69	14	29	23	52	31
2035	4	66	70	14	30	23	54	30
2036	4	66	70	14	32	24	55	28
2037	4	67	71	14	33	24	57	27
2038	4	67	71	14	35	24	59	26
2039	4	68	72	14	36	25	61	25
2040	4	68	72	14	38	25	63	24

3. Rain Barrels

a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Willis Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association
- County-Wide WUGs:

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Other (Rural/unincorporated areas of municipal water use)
- Manufacturing
- Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Willis' current water conservation activities and their quantified savings to two metrics: 1) Region H Water Plan's (Texas Water Development Board, 2016g) recommended WMS supply volumes for municipal conservation, and 2) Willis' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Willis' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Willis with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0.8	11	12	1	0	1	11
2016	0.8	11	12	1	0	1	11
2017	0.6	11	12	1	0	1	11
2018	0.5	11	12	2	0	2	10
2019	0.3	12	12	2	0	2	10
2020	0.1	12	12	2	0	2	10
2021	0	12	12	3	0	3	9
2022	0	12	12	3	0	3	9
2023	0	12	12	3	0	3	9
2024	0	12	12	4	0	4	8
2025	0	12	12	4	0	4	8
2026	0	12	12	4	0	4	8
2027	0	12	12	5	0	5	8
2028	0	12	12	5	0	5	7
2029	0	12	12	5	0	5	7
2030	0	12	12	6	0	6	7
2031	0	12	12	6	0	6	6
2032	0	12	12	6	0	6	6
2033	0	12	12	6	0	6	6
2034	0	12	12	6	0	6	6
2035	0	13	13	7	0	7	6
2036	0	13	13	7	0	7	6
2037	0	13	13	7	0	7	6
2038	0	13	13	7	0	7	5
2039	0	13	13	8	0	8	5
2040	0	13	13	8	0	8	5
2041	0	13	13	8	0	8	5
2042	0	13	13	9	0	9	4
2043	0	13	13	9	0	9	4
2044	0	13	13	10	0	10	4
2045	0	14	14	10	0	10	3
2046	0	14	14	11	0	11	3
2047	0	14	14	11	0	11	3
2048	0	14	14	12	0	12	2
2049	0	14	14	12	0	12	2
2050	0	14	14	13	0	13	2
2051	0	14	14	13	0	13	2
2052	0	15	15	13	0	13	1
2053	0	15	15	13	0	13	1
2054	0	15	15	13	0	13	1
2055	0	15	15	14	0	14	1
2056	0	15	15	14	0	14	2
2057	0	15	15	14	0	14	2
2058	0	16	16	14	0	14	2
2059	0	16	16	14	0	14	2
2060	0	16	16	14	0	14	2
2061	0	16	16	15	0	15	2
2062	0	16	16	15	0	15	2
2063	0	16	16	15	0	15	2
2064	0	17	17	15	0	15	2
2065	0	17	17	15	0	15	2
2066	0	17	17	15	0	15	2
2067	0	18	18	15	0	15	2
2068	0	18	18	16	0	16	2
2069	0	18	18	16	0	16	2
2070	0	18	18	16	0	16	2

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Willis quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	110	0	0	0
1	2015	6,280	110	0	12	11
2	2016	6,331	110	1	12	11
3	2017	6,381	109	1	12	11
4	2018	6,432	109	2	12	10
5-year Goal	2019	6,482	109	2	12	9
6	2020	6,533	109	3	12	9
7	2021	6,557	109	3	12	8
8	2022	6,580	108	4	12	8
9	2023	6,604	108	4	12	8
10-year Goal	2024	6,627	108	5	12	7

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Willis' most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	8.00	0	0	0
1	2015	6,280	7.80	0	11	11
2	2016	6,331	7.60	1	11	10
3	2017	6,381	7.40	1	11	10
4	2018	6,432	7.20	2	11	10
5-year Goal	2019	6,482	7.00	2	12	9
6	2020	6,533	7.00	2	12	9
7	2021	6,557	7.00	2	12	9
8	2022	6,580	7.00	2	12	9
9	2023	6,604	7.00	2	12	10
10-year Goal	2024	6,627	7.00	2	12	10

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 11 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
    c. 15% adoption rate assumed

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	TOTAL SAVINGS
2009	0.2	0.2
2010	0.3	0.3
2011	0.4	0.4
2012	0.6	0.6
2013	0.7	0.7
2014	0.7	0.7
2015	0.8	0.8
2016	0.8	0.8
2017	0.6	0.6
2018	0.5	0.5
2019	0.3	0.3
2020	0.1	0.1
2021		0
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0
2031		0
2032		0
2033		0
2034		0
2035		0
2036		0
2037		0
2038		0
2039		0
2040		0
2041		0
2042		0
2043		0
2044		0
2045		0
2046		0
2047		0
2048		0
2049		0
2050		0
2051		0
2052		0
2053		0
2054		0
2055		0
2056		0
2057		0
2058		0
2059		0
2060		0
2061		0
2062		0
2063		0
2064		0
2065		0
2066		0
2067		0
2068		0
2069		0
2070		0

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	8.00	0
2015	6,048	3.00	11
2016	6,125	3.00	11
2017	6,203	3.00	11
2018	6,280	3.00	11
2019	6,331	3.00	12
2020	6,381	3.00	12
2021	6,432	3.00	12
2022	6,482	3.00	12
2023	6,533	3.00	12
2024	6,557	3.00	12

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region H savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 11 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	11	12	11	1	0	1	21
2017	1	11	12	11	1	0	1	21
2018	0	11	12	11	2	0	2	21
2019	0	12	12	11	2	0	2	21
2020	0	12	12	11	2	0	2	20
2021	0	12	12	11	3	0	3	20
2022	0	12	12	11	3	0	3	20
2023	0	12	12	11	3	0	3	19
2024	0	12	12	11	4	0	4	19
2025	0	12	12	11	4	0	4	19
2026	0	12	12	11	4	0	4	19
2027	0	12	12	11	5	0	5	18
2028	0	12	12	11	5	0	5	18
2029	0	12	12	11	5	0	5	18
2030	0	12	12	11	6	0	6	17
2031	0	12	12	11	6	0	6	17
2032	0	12	12	11	6	0	6	17
2033	0	12	12	11	6	0	6	17
2034	0	12	12	11	6	0	6	17
2035	0	13	13	11	7	0	7	17
2036	0	13	13	11	7	0	7	17
2037	0	13	13	11	7	0	7	17
2038	0	13	13	11	7	0	7	17
2039	0	13	13	11	8	0	8	17
2040	0	13	13	11	8	0	8	17

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	11	12	4	1	0	1	14
2017	1	11	12	4	1	0	1	14
2018	0	11	12	4	2	0	2	14
2019	0	12	12	4	2	0	2	14
2020	0	12	12	4	2	0	2	13
2021	0	12	12	4	3	0	3	13
2022	0	12	12	4	3	0	3	12
2023	0	12	12	4	3	0	3	12
2024	0	12	12	4	4	0	4	12
2025	0	12	12	4	4	0	4	12
2026	0	12	12	4	4	0	4	11
2027	0	12	12	4	5	0	5	11
2028	0	12	12	4	5	0	5	11
2029	0	12	12	4	5	0	5	11
2030	0	12	12	4	6	0	6	10
2031	0	12	12	4	6	0	6	10
2032	0	12	12	4	6	0	6	10
2033	0	12	12	4	6	0	6	10
2034	0	12	12	4	6	0	6	10
2035	0	13	13	4	7	0	7	10
2036	0	13	13	4	7	0	7	9
2037	0	13	13	4	7	0	7	9
2038	0	13	13	4	7	0	7	9
2039	0	13	13	4	8	0	8	9
2040	0	13	13	4	8	0	8	9

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 5 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1	11	12	5	1	0	1	16
2017	1	11	12	5	1	0	1	16
2018	0	11	12	5	2	0	2	16
2019	0	12	12	5	2	0	2	15
2020	0	12	12	5	2	0	2	15
2021	0	12	12	5	3	0	3	14
2022	0	12	12	5	3	0	3	14
2023	0	12	12	5	3	0	3	14
2024	0	12	12	5	4	0	4	14
2025	0	12	12	5	4	0	4	13
2026	0	12	12	5	4	0	4	13
2027	0	12	12	5	5	0	5	13
2028	0	12	12	5	5	0	5	13
2029	0	12	12	5	5	0	5	12
2030	0	12	12	5	6	0	6	12
2031	0	12	12	5	6	0	6	12
2032	0	12	12	5	6	0	6	12
2033	0	12	12	5	6	0	6	12
2034	0	12	12	6	6	0	6	12
2035	0	13	13	6	7	0	7	11
2036	0	13	13	6	7	0	7	11
2037	0	13	13	6	7	0	7	11
2038	0	13	13	6	7	0	7	11
2039	0	13	13	6	8	0	8	11
2040	0	13	13	6	8	0	8	11

4. Rain Barrels
    a. In Region H, utilities could save approximately 26.8 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Region J Individual Reports

Statewide Water Conservation Quantification Project
City of Del Rio Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Del Rio's current water conservation activities and their quantified savings to two metrics: 1) Region J Water Plan's (Texas Water Development Board, 2016h) recommended WMS supply volumes for municipal conservation, and 2) Del Rio's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Del Rio's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Del Rio with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	490	490	17	0	17	472
2016	0	495	495	22	0	22	473
2017	0	499	499	22	0	22	478
2018	0	504	504	26	0	26	479
2019	0	509	509	30	0	30	479
2020	0	514	514	39	0	39	476
2021	0	518	518	39	0	39	479
2022	0	521	521	39	0	39	482
2023	0	524	524	39	0	39	485
2024	0	527	527	39	0	39	489
2025	0	531	531	39	0	39	492
2026	0	534	534	39	0	39	495
2027	0	537	537	39	0	39	499
2028	0	541	541	39	0	39	502
2029	0	544	544	39	0	39	505
2030	0	547	547	39	0	39	508
2031	0	550	550	39	0	39	512
2032	0	554	554	39	0	39	515
2033	0	557	557	39	0	39	518
2034	0	560	560	39	0	39	521
2035	0	563	563	39	0	39	524
2036	0	566	566	39	0	39	528
2037	0	570	570	39	0	39	531
2038	0	573	573	39	0	39	534
2039	0	576	576	39	0	39	537
2040	0	579	579	39	0	39	540
2041	0	582	582	39	0	39	544
2042	0	586	586	39	0	39	547
2043	0	589	589	39	0	39	550
2044	0	592	592	39	0	39	554
2045	0	596	596	39	0	39	557
2046	0	599	599	39	0	39	560
2047	0	602	602	39	0	39	563
2048	0	605	605	39	0	39	567
2049	0	609	609	39	0	39	570
2050	0	612	612	39	0	39	573
2051	0	615	615	39	0	39	576
2052	0	618	618	39	0	39	579
2053	0	621	621	39	0	39	583
2054	0	624	624	39	0	39	586
2055	0	628	628	39	0	39	589
2056	0	631	631	39	0	39	592
2057	0	634	634	39	0	39	595
2058	0	637	637	39	0	39	598
2059	0	640	640	39	0	39	601
2060	0	643	643	39	0	39	604
2061	0	646	646	39	0	39	607
2062	0	649	649	39	0	39	610
2063	0	652	652	39	0	39	613
2064	0	655	655	39	0	39	616
2065	0	658	658	39	0	39	619
2066	0	661	661	39	0	39	622
2067	0	664	664	39	0	39	625
2068	0	667	667	39	0	39	629
2069	0	670	670	39	0	39	632
2070	0	673	673	39	0	39	635

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Del Rio's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	36,255	147	40	490	450
2	2016	36,621	144	80	495	414
3	2017	36,986	141	121	499	378
4	2018	37,352	138	164	504	341
5-year Goal	2019	37,717	135	207	509	303
6	2020	38,083	134	228	514	286
7	2021	38,327	132	249	518	269
8	2022	38,571	131	270	521	251
9	2023	38,815	129	292	524	232
10-year Goal	2024	39,059	128	314	527	214

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Del Rio's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	53.00	0	0	0
1	2015	36,255	52.40	8	490	482
2	2016	36,621	51.80	16	495	479
3	2017	36,986	51.20	24	499	475
4	2018	37,352	50.60	33	504	472
5-year Goal	2019	37,717	50.00	41	509	468
6	2020	38,083	49.00	56	514	459
7	2021	38,327	48.00	70	518	448
8	2022	38,571	47.00	84	521	436
9	2023	38,815	46.00	99	524	425
10-year Goal	2024	39,059	45.00	114	527	413

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 490 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Water Loss Reduction Savings
2014	35,589	53.00	0
2015	36,255	16.00	490
2016	36,621	16.00	495
2017	36,986	16.00	499
2018	37,352	16.00	504
2019	37,717	16.00	509
2020	38,083	16.00	514
2021	38,327	16.00	518
2022	38,571	16.00	521
2023	38,815	16.00	524
2024	39,059	16.00	527

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	495	495	46	22	0	22	519
2017	0	499	499	46	22	0	22	524
2018	0	504	504	46	26	0	26	525
2019	0	509	509	46	30	0	30	525
2020	0	514	514	46	39	0	39	522
2021	0	518	518	47	39	0	39	526
2022	0	521	521	47	39	0	39	529
2023	0	524	524	47	39	0	39	533
2024	0	527	527	47	39	0	39	536
2025	0	531	531	48	39	0	39	540
2026	0	534	534	48	39	0	39	543
2027	0	537	537	48	39	0	39	547
2028	0	541	541	48	39	0	39	550
2029	0	544	544	48	39	0	39	554
2030	0	547	547	49	39	0	39	557
2031	0	550	550	49	39	0	39	561
2032	0	554	554	49	39	0	39	564
2033	0	557	557	49	39	0	39	567
2034	0	560	560	50	39	0	39	571
2035	0	563	563	50	39	0	39	574
2036	0	566	566	50	39	0	39	578
2037	0	570	570	50	39	0	39	581
2038	0	573	573	50	39	0	39	584
2039	0	576	576	51	39	0	39	588
2040	0	579	579	51	39	0	39	591

2. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 68 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	495	495	68	22	0	22	541
2017	0	499	499	68	22	0	22	546
2018	0	504	504	69	26	0	26	547
2019	0	509	509	69	30	0	30	548
2020	0	514	514	69	39	0	39	545
2021	0	518	518	70	39	0	39	549
2022	0	521	521	70	39	0	39	552
2023	0	524	524	70	39	0	39	556
2024	0	527	527	71	39	0	39	559
2025	0	531	531	71	39	0	39	563
2026	0	534	534	71	39	0	39	567
2027	0	537	537	72	39	0	39	570
2028	0	541	541	72	39	0	39	574
2029	0	544	544	72	39	0	39	578
2030	0	547	547	73	39	0	39	581
2031	0	550	550	73	39	0	39	585
2032	0	554	554	73	39	0	39	588
2033	0	557	557	74	39	0	39	592
2034	0	560	560	74	39	0	39	595
2035	0	563	563	74	39	0	39	599
2036	0	566	566	75	39	0	39	602
2037	0	570	570	75	39	0	39	606
2038	0	573	573	75	39	0	39	609
2039	0	576	576	76	39	0	39	613
2040	0	579	579	76	39	0	39	616

TWDB Statewide Water Conservation Quantification Project
City of Kerrville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association
- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, we first engaged with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

We then quantified each utility’s conservation activities through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Kerrville's current water conservation activities and their quantified savings to two metrics: 1) Region J Water Plan's (Texas Water Development Board, 2016h) recommended WMS supply volumes for municipal conservation, and 2) Kerrville's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Kerrville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. We are not aware of all activities that are ongoing. Some activities within a utility's service area are implemented on a micro-scale that we cannot yet quantify. Individual households and businesses may be implementing conservation measures that we do not know about and therefore cannot include in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures we have carried forward in our model because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. Our approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Kerrville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

---

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. Because the regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, we have quantified utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	45	(102)	(57)	0	21	21	(78)
2016	45	(102)	(57)	0	27	27	(84)
2017	45	(102)	(57)	0	32	32	(89)
2018	45	(102)	(57)	0	37	37	(94)
2019	45	(102)	(57)	0	43	43	(100)
2020	45	(102)	(57)	0	48	48	(105)
2021	45	(103)	(57)	0	48	48	(105)
2022	45	(103)	(58)	0	48	48	(106)
2023	45	(103)	(58)	0	48	48	(106)
2024	45	(104)	(58)	0	48	48	(106)
2025	45	(104)	(59)	0	48	48	(106)
2026	46	(104)	(59)	0	48	48	(107)
2027	46	(105)	(59)	0	48	48	(107)
2028	46	(105)	(60)	0	48	48	(107)
2029	46	(106)	(60)	0	48	48	(108)
2030	46	(106)	(60)	0	48	48	(108)
2031	46	(106)	(60)	0	48	48	(108)
2032	46	(106)	(61)	0	48	48	(109)
2033	46	(107)	(61)	0	48	48	(109)
2034	46	(107)	(61)	0	48	48	(109)
2035	46	(107)	(61)	0	48	48	(109)
2036	46	(107)	(61)	0	48	48	(109)
2037	46	(108)	(62)	0	48	48	(110)
2038	46	(108)	(62)	0	48	48	(110)
2039	46	(108)	(62)	0	48	48	(110)
2040	46	(108)	(62)	0	48	48	(110)
2041	46	(109)	(63)	0	48	48	(110)
2042	46	(109)	(63)	0	48	48	(111)
2043	46	(109)	(63)	0	48	48	(111)
2044	46	(109)	(63)	0	48	48	(111)
2045	46	(109)	(63)	0	48	48	(111)
2046	46	(110)	(63)	0	48	48	(111)
2047	46	(110)	(64)	0	48	48	(111)
2048	46	(110)	(64)	0	48	48	(112)
2049	46	(110)	(64)	0	48	48	(112)
2050	47	(111)	(64)	0	48	48	(112)
2051	47	(111)	(64)	0	48	48	(112)
2052	47	(111)	(64)	0	48	48	(112)
2053	47	(111)	(64)	0	48	48	(112)
2054	47	(111)	(65)	0	48	48	(112)
2055	47	(111)	(65)	0	48	48	(113)
2056	47	(112)	(65)	0	48	48	(113)
2057	47	(112)	(65)	0	48	48	(113)
2058	47	(112)	(65)	0	48	48	(113)
2059	47	(112)	(65)	0	48	48	(113)
2060	47	(112)	(65)	0	48	48	(113)
2061	47	(112)	(65)	0	48	48	(113)
2062	47	(113)	(65)	0	48	48	(113)
2063	47	(113)	(65)	0	48	48	(113)
2064	47	(113)	(65)	0	48	48	(113)
2065	47	(113)	(66)	0	48	48	(113)
2066	47	(113)	(66)	0	48	48	(113)
2067	48	(113)	(66)	0	48	48	(114)
2068	48	(113)	(66)	0	48	48	(114)
2069	48	(113)	(66)	0	48	48	(114)
2070	48	(114)	(66)	0	48	48	(114)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Kerrville's quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	167	0	0	0
1	2015	22,858	165	20	(57)	(77)
2	2016	22,950	162	40	(57)	(97)
3	2017	23,042	160	61	(57)	(118)
4	2018	23,135	157	81	(57)	(138)
5-year Goal	2019	23,227	155	102	(57)	(159)
6	2020	23,319	154	111	(57)	(168)
7	2021	23,408	153	120	(57)	(177)
8	2022	23,497	152	129	(58)	(186)
9	2023	23,586	151	138	(58)	(196)
10-year Goal	2024	23,675	150	147	(58)	(205)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Kerrville's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	29.00	0	0	0
1	2015	22,858	28.00	8	(102)	(110)
2	2016	22,950	27.00	17	(102)	(119)
3	2017	23,042	26.00	25	(102)	(127)
4	2018	23,135	25.00	34	(102)	(136)
5-year Goal	2019	23,227	24.00	42	(102)	(145)
6	2020	23,319	23.20	49	(102)	(152)
7	2021	23,408	22.40	56	(103)	(159)
8	2022	23,497	21.60	63	(103)	(166)
9	2023	23,586	20.80	71	(103)	(174)
10-year Goal	2024	23,675	20.00	78	(104)	(181)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 102 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 15.0% increase in 2013
    b. Estimated customer demand reduction of 3.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
d. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013	45	45
2014	45	45
2015	45	45
2016	45	45
2017	45	45
2018	45	45
2019	45	45
2020	45	45
2021	45	45
2022	45	45
2023	45	45
2024	45	45
2025	45	45
2026	46	46
2027	46	46
2028	46	46
2029	46	46
2030	46	46
2031	46	46
2032	46	46
2033	46	46
2034	46	46
2035	46	46
2036	46	46
2037	46	46
2038	46	46
2039	46	46
2040	46	46
2041	46	46
2042	46	46
2043	46	46
2044	46	46
2045	46	46
2046	46	46
2047	46	46
2048	46	46
2049	46	46
2050	47	47
2051	47	47
2052	47	47
2053	47	47
2054	47	47
2055	47	47
2056	47	47
2057	47	47
2058	47	47
2059	47	47
2060	47	47
2061	47	47
2062	47	47
2063	47	47
2064	47	47
2065	47	47
2066	47	47
2067	48	48
2068	48	48
2069	48	48
2070	48	48

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	29.00	0
2015	23,319	41.00	(102)
2016	23,319	41.00	(102)
2017	23,319	41.00	(102)
2018	23,319	41.00	(102)
2019	23,319	41.00	(102)
2020	23,319	41.00	(102)
2021	23,408	41.00	(103)
2022	23,497	41.00	(103)
2023	23,586	41.00	(103)
2024	23,675	41.00	(104)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 7.79% savings of total demand Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region J savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 117 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	45	(102)	(57)	117	0	27	27	33
2017	45	(102)	(57)	117	0	32	32	28
2018	45	(102)	(57)	117	0	37	37	23
2019	45	(102)	(57)	117	0	43	43	17
2020	45	(102)	(57)	117	0	48	48	12
2021	45	(103)	(57)	117	0	48	48	12
2022	45	(103)	(58)	118	0	48	48	12
2023	45	(103)	(58)	118	0	48	48	12
2024	45	(104)	(58)	118	0	48	48	12
2025	45	(104)	(59)	118	0	48	48	12
2026	46	(104)	(59)	118	0	48	48	11
2027	46	(105)	(59)	118	0	48	48	11
2028	46	(105)	(60)	119	0	48	48	11
2029	46	(106)	(60)	119	0	48	48	11
2030	46	(106)	(60)	119	0	48	48	11
2031	46	(106)	(60)	119	0	48	48	11
2032	46	(106)	(61)	119	0	48	48	11
2033	46	(107)	(61)	119	0	48	48	10
2034	46	(107)	(61)	119	0	48	48	10
2035	46	(107)	(61)	119	0	48	48	10
2036	46	(107)	(61)	119	0	48	48	10
2037	46	(108)	(62)	119	0	48	48	10
2038	46	(108)	(62)	119	0	48	48	10
2039	46	(108)	(62)	119	0	48	48	9
2040	46	(108)	(62)	119	0	48	48	9

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	45	(102)	(57)	20	0	27	27	(64)
2017	45	(102)	(57)	20	0	32	32	(69)
2018	45	(102)	(57)	20	0	37	37	(74)
2019	45	(102)	(57)	20	0	43	43	(79)
2020	45	(102)	(57)	20	0	48	48	(85)
2021	45	(103)	(57)	20	0	48	48	(85)
2022	45	(103)	(58)	20	0	48	48	(85)
2023	45	(103)	(58)	20	0	48	48	(86)
2024	45	(104)	(58)	20	0	48	48	(86)
2025	45	(104)	(59)	20	0	48	48	(86)
2026	46	(104)	(59)	20	0	48	48	(86)
2027	46	(105)	(59)	20	0	48	48	(87)
2028	46	(105)	(60)	20	0	48	48	(87)
2029	46	(106)	(60)	20	0	48	48	(87)
2030	46	(106)	(60)	20	0	48	48	(88)
2031	46	(106)	(60)	20	0	48	48	(88)
2032	46	(106)	(61)	20	0	48	48	(88)
2033	46	(107)	(61)	20	0	48	48	(88)
2034	46	(107)	(61)	21	0	48	48	(88)
2035	46	(107)	(61)	21	0	48	48	(89)
2036	46	(107)	(61)	21	0	48	48	(89)
2037	46	(108)	(62)	21	0	48	48	(89)
2038	46	(108)	(62)	21	0	48	48	(89)
2039	46	(108)	(62)	21	0	48	48	(89)
2040	46	(108)	(62)	21	0	48	48	(90)

3. Rain Barrels
   a. In Region J, utilities could save approximately 12.6 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Region K Individual Reports

Statewide Water Conservation Quantification Project
City of Austin Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Austin's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Austin's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Austin's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Austin with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-6.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	8,002	(923)	7,079	3,327	0	3,327	3,752
2016	11,853	94	11,947	4,159	0	4,159	7,788
2017	11,772	96	11,868	4,159	0	4,159	7,709
2018	11,546	99	11,645	4,990	0	4,990	6,655
2019	11,681	101	11,782	5,822	0	5,822	5,960
2020	11,844	104	11,948	7,486	0	7,486	4,462
2021	12,019	106	12,125	7,537	0	7,537	4,587
2022	12,155	108	12,263	7,589	0	7,589	4,674
2023	12,303	110	12,413	7,641	0	7,641	4,772
2024	12,445	112	12,557	7,693	0	7,693	4,864
2025	12,598	114	12,712	7,745	0	7,745	4,967
2026	12,766	116	12,882	7,797	0	7,797	5,085
2027	12,934	118	13,052	7,848	0	7,848	5,204
2028	13,120	120	13,240	7,900	0	7,900	5,340
2029	13,305	122	13,428	7,952	0	7,952	5,476
2030	13,491	124	13,616	8,004	0	8,004	5,612
2031	13,691	127	13,818	8,126	0	8,126	5,692
2032	13,891	129	14,020	8,249	0	8,249	5,771
2033	14,091	131	14,222	8,371	0	8,371	5,851
2034	14,290	133	14,423	8,494	0	8,494	5,929
2035	14,490	135	14,625	8,616	0	8,616	6,009
2036	14,690	137	14,827	8,739	0	8,739	6,088
2037	14,890	139	15,029	8,861	0	8,861	6,168
2038	15,089	141	15,230	8,984	0	8,984	6,246
2039	15,289	143	15,432	9,106	0	9,106	6,326
2040	15,488	146	15,634	9,229	0	9,229	6,405
2041	15,643	148	15,791	9,323	0	9,323	6,468
2042	15,797	150	15,947	9,418	0	9,418	6,529
2043	15,951	153	16,104	9,512	0	9,512	6,592
2044	16,106	155	16,261	9,607	0	9,607	6,654
2045	16,260	158	16,418	9,702	0	9,702	6,716
2046	16,414	160	16,574	9,796	0	9,796	6,778
2047	16,568	163	16,731	9,891	0	9,891	6,840
2048	16,723	165	16,888	9,985	0	9,985	6,903
2049	16,877	168	17,045	10,080	0	10,080	6,965
2050	17,031	170	17,201	10,175	0	10,175	7,026
2051	17,170	173	17,343	10,259	0	10,259	7,083
2052	17,308	176	17,484	10,344	0	10,344	7,140
2053	17,446	179	17,625	10,429	0	10,429	7,196
2054	17,585	182	17,766	10,514	0	10,514	7,253
2055	17,722	185	17,907	10,599	0	10,599	7,308
2056	17,861	187	18,049	10,683	0	10,683	7,365
2057	17,999	190	18,189	10,768	0	10,768	7,421
2058	18,138	193	18,331	10,853	0	10,853	7,478
2059	18,275	196	18,471	10,938	0	10,938	7,534
2060	18,414	199	18,613	11,023	0	11,023	7,590
2061	18,577	202	18,779	11,123	0	11,123	7,657
2062	18,741	205	18,946	11,223	0	11,223	7,723
2063	18,904	208	19,112	11,323	0	11,323	7,789
2064	19,067	211	19,279	11,424	0	11,424	7,855
2065	19,232	215	19,446	11,524	0	11,524	7,922
2066	19,395	218	19,613	11,624	0	11,624	7,989
2067	19,558	221	19,779	11,725	0	11,725	8,055
2068	19,722	224	19,946	11,825	0	11,825	8,121
2069	19,885	227	20,112	11,925	0	11,925	8,187
2070	20,049	230	20,280	12,025	0	12,025	8,254

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Austin's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Section 5 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	162	0	0	0
1	2015	926,624	158	1,421	7,079	5,658
2	2016	951,497	154	2,917	11,947	9,030
3	2017	976,371	149	4,490	11,868	7,378
4	2018	1,001,244	145	6,140	11,645	5,505
5-year Goal	2019	1,026,118	141	7,865	11,782	3,917
6	2020	1,050,991	140	8,286	11,948	3,662
7	2021	1,072,217	140	8,688	12,125	3,436
8	2022	1,093,444	139	9,100	12,263	3,163
9	2023	1,114,670	139	9,520	12,413	2,892
10-year Goal	2024	1,135,896	138	9,950	12,557	2,607

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Austin's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-6 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	Baseline	-	17.27	0	0	0
1	2015	926,624	16.67	204	(923)	(1,127)
2	2016	951,497	16.07	418	94	(324)
3	2017	976,371	15.46	644	96	(547)
4	2018	1,001,244	14.86	880	99	(781)
5-year Goal	2019	1,026,118	14.26	1,127	101	(1,026)
6	2020	1,050,991	14.20	1,177	104	(1,073)
7	2021	1,072,217	14.14	1,223	106	(1,118)
8	2022	1,093,444	14.09	1,271	108	(1,163)
9	2023	1,114,670	14.03	1,319	110	(1,209)
10-year Goal	2024	1,135,896	13.97	1,368	112	(1,256)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

4.1.1 Service Area-wide and Ordinance Activities

1. **Outdoor Watering Ordinances**
    a. 2007 Peak-season restriction to twice-per-week (Austin Water, 2016)
        i. Single-family (SF) savings = 5.43 million gallons daily (MGD) or 1,981.95 MG annually by 2020
        ii. Multi-family (MF) savings = 0.99 MGD or 361.35 MG annually by 2020
        iii. Institutional-Commercial-Industrial (ICI) savings = 3.58 MGD or 1,306.7 MG annually by 2020
    b. 2012 Year-round restriction to twice-per-week (Austin Water, 2016)
        i. Additional SF savings of 0.48 MGD
        ii. 5.91 MGD total for SF customers or 2,157.15 MG annually by 2020
        iii. Total for all customer classes = 10.48 MGD or 3,825.2 MG annually by 2020
    c. 2016 Year-round restriction to once-per-week
        i. Estimated savings of 6.6% of total demand in addition to savings from year-round restriction to twice-per-week
            1. Utility staff estimated between 6.6% and 8.8% (Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
            2. The lower figure was quantified to be conservative
    d. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

2. **Conservation Pricing and Water Rate Increases**
    a. Tiered rate structure price increases effective in 2013 (Austin Water, 2016)
        i. SF savings = 3.7 MGD or 1,350.5 MG annually by 2020
        ii. MF savings = 2.8 MGD or 1,022 MG annually by 2020
        iii. ICI savings = 1.6 MGD or 584 MG annually by 2020
        iv. Combined savings = 8.1 MGD or 2,956.5 MG annually by 2020
        v. 2,956.5 MG annually amounts to 5.492% of demand
        vi. Savings grow with demand in future years
    b. The last two major rate increases:[15]
        i. 4.9% combined rate revenue increase in 2015
        ii. 3% combined rate revenue increase in 2016
        iii. 7.9% increase = 1.58% of total demand
    c. Estimated total demand reduction of 7.072% with tiered rate increase and two most recent rate increases
    d. Savings are cumulative and based on TWDB's Best Management Practices for Municipal Water Users Guide,[16] as well as Environmental Protection Agency guidelines and other sources (U.S. EPA, 1998; Whitcomb, 1999).

[15] Correspondence with utility staff.
[16] Water Conservation Advisory Council (WCAC) estimates 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

3. **Irrigation System Permits (Code)**
    a. Estimated savings of 0.49 MGD or 178.85 MG annually by 2017 (Austin Water, 2016)
        i. Code established in 2008
            1. Full savings realized in 10 years, or 2017

4. **Stormwater Landscape Ordinance (ICI)**
    a. Estimated savings of 15,744.5 gallons per day or 5.746 MG per year (Austin Water, 2016)
    b. Savings estimates grow each year at the same rate demand figures for Austin grow in the regional water plan.

5. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative five-year useful life for all items in kit
    c. 15% adoption rate assumed

6. **Water Waste Administrative Enforcement**
    a. Utility staff estimates savings of 37.5 gallons per day during peak-season (Austin Water, 2016)
    b. 37.5 gallons per day for 150 days (5 months of peak season) = 5,625 gallons
    c. Assumed a conservative 9.375 gallons per day (25% of peak season figure) for 215 days (7 months of off-peak season) = 2,015 gallons
    d. Total of 7,640 per year per citation
    e. Savings expected to persist for 3 years after citation issued
    f. Number of citations were not separated by customer class in materials provided by staff

7. **Rainwater Harvesting Rebate**
    a. Estimated 24.61 gallons per day per rebate issued (Austin Water, 2016)
    b. 10-year useful life

8. **Dropcountr Home Water Use Reports**
    a. Not quantified for this report
        i. Lacked sufficient support material to estimate savings for monthly usage reports
        ii. Dropcountr may be able to provide specific savings estimates for its monthly program.
    b. Other customer engagement portal studies show that 20% of residential customers could save 10% of their consumption over a year's time with potential to save more as more customers engage with the portal's features (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
        i. See Section 6 for details on potential savings.

4.1.2 Single-family Residential Activities

9. Free Toilet Voucher Program

a. Estimated savings of 8,440 gallons per year per toilet for 1.6 gallons per flush Ultra-Low Flush (ULF) model (A&N Technical Services, 2005)
b. Number of vouchers per year provided by staff
c. 10-year useful life
d. Replaced by 1.28 gallons per flush model at the end of useful life
    i. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)

10. High Efficiency (HE) Toilet Rebate

a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
b. Savings carry on indefinitely because replacement toilet will be as efficient

11. Clothes Washer Rebate

a. Estimated 14.5 gallons per day for single-family customers or 5,293 gallons per year per washer (Austin Water, 2016)
b. 13-years useful life

12. Free Irrigation System Efficiency Evaluation

a. Estimated 205.1 gallons per day savings or 74,862 gallons per year per audit (Austin Water, 2016)
b. Savings expected to persist 3 years after evaluation

13. Irrigation Update Rebate

a. Estimated savings of 50 gallons per day or 18,250 gallons per year per rebate (GDS Associates, 2002)
b. Savings expected to last 3 years after rebate issued

14. Lawn Conversion (WaterWise) Rebate

a. Estimated savings of 59.1 gallons per day or 21,572 gallons per year per rebate (Austin Water, 2016)
b. 10-year useful life

15. Showerhead Distribution

a. Estimated 10.48 gallons per day savings or 3,825.2 gallons per year per showerhead (Austin Water, 2016)
b. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

16. Bathroom/Kitchen Faucet Aerator Distribution

a. Estimated 5.43 gallons per day savings or 1,982 gallons per year per aerator (Austin Water, 2016)
b. 5-year useful life

17. Soil Moisture Monitor Distribution

a. Savings estimate not available

18. Tree Gator Distribution

a. Estimated 0.54 gallons per day savings or 391 gallons per year per Tree Gator (Austin Water, 2016)
b. 5-year useful life

19. Pool Cover Rebate

a. Estimated 21.88 gallons per day savings or 7,986 gallons per year per pool cover (Austin Water, 2016)
b. 10-year useful life

20. Hose Timer Rebate

a. Estimated 18.28 gallons per day savings or 6,672.2 gallons per year per hose timer (Austin Water, 2016)
b. 3-year useful life

21. Pressure Regulating Valve Rebate

a. Estimated 23.56 gallons per day savings or 8,600 gallons per year per valve (Austin Water, 2016)
b. 10-year useful life

4.1.3 Multi-family Residential Activities

22. Free Toilet Voucher Program

a. Estimated savings of 12,810 gallons per year per toilet for 1.6 gallons per flush ULF model (A&N Technical Services, 2005)
b. Number of vouchers per year provided by staff
c. 10-year useful life
d. Replaced by 1.28 gallons per flush model at the end of useful life
    i. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)

23. HE Toilet Rebate

a. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
b. Savings carry on indefinitely because replacement toilet will be as efficient

24. Clothes Washer Rebate

a. Estimated 81.46 gallons per day for multi-family customers or 29,733 gallons per year per washer (Austin Water, 2016)
b. 8-year useful life

25. Lawn Conversion (WaterWise) Rebate

a. Savings estimate not available
b. Only one issued in years analyzed (2014)

26. Pressure Regulating Valve Rebate

a. Variable savings for multi-family customers
b. No rebates issued for years analyzed

27. Showerhead Distribution

a. Estimated 8.06 gallons per day savings or gallons per year per showerhead (Austin Water, 2016)
b. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

28. Bathroom/Kitchen Faucet Aerator Distribution

a. Estimated 3.98 gallons per day or 1,453 gallons per year per aerator (Austin Water, 2016)
b. 5-year useful life

29. Soil Moisture Monitor Distribution

a. Savings estimate not available

30. Tree Gator Distribution

a. Savings estimate not available
b. No rebates issued for years analyzed

4.1.4 Commercial Activities

31. Free Toilet Voucher Program

a. Estimated savings of 10,580 gallons per year per toilet for 1.6 gallons per flush ULF model (A&N Technical Services, 2005)
b. Number of vouchers per year provided by staff
c. 10-year useful life
d. Replaced by 1.28 gallons per flush model at the end of useful life
    i. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)

32. HE Toilet Rebate

a. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
b. Savings carry on indefinitely because replacement toilet will be as efficient

33. Clothes Washer Rebate

a. Estimated 81.46 gallons per day for multi-family customers or 29,733 gallons per year per washer (Austin Water, 2016)
b. 8-year useful life

34. Irrigation Controller Rebate

a. Estimated conservative savings of 11,340 gallons per year per controller

b. Used EPA WaterSense Water Budget Tool Formula[17] with 4,000 sq. ft. as basis for landscape hydrozone (U.S. EPA, 2017)
c. Number of rebates per year provided by staff
d. Savings assumed to last 10 years with no decay rate

35. Commercial Irrigation Rebate
a. Savings estimate not available
b. Minimal rebates issued

36. ICI Audit
a. Savings estimate not available
b. Minimal rebates issued

37. Commercial Kitchen Rebate
a. Variable savings
b. No rebates issued for years analyzed

38. Commercial Process Rebate
a. Variable savings
b. Minimal rebates issued

39. Mandatory Commercial Facility Irrigation Assessment
a. Conservatively estimated 500 gallons per day savings or 182,500 gallons per year per assessment (Austin Water, 2016)
b. 3-year life for each assessment

40. Mandatory Commercial Vehicle Facility Efficiency Assessment
a. Savings estimate not available

[17] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$

5 Summary of Savings

Table 5-1. Savings for Service Area-wide and Ordinance Activities (MG).

Year	Outdoor Watering Ordinances	Conservation Pricing Increases	Water Rate Increases	Irrigation System Permits	Stormwater Landscape Ordinance (ICI)	WaterWise Take-home Kits	Water Waste Violations + Inspections	Rainwater Harvesting	TOTAL SAVINGS
2010	Variable			54	6		26	23.5	109
2011	Variable			72	6	0.2	94	26.1	198
2012	3,316			90	6	0.4	135	26.5	3,574
2013	3,380	2,612		107	6	0.7	156	27.0	6,289
2014	3,443	2,661		125	6	0.9	152	27.9	6,417
2015	3,507	2,711	296	143	6	0.9	161	28.3	6,854
2016	6,887	2,760	794	161	6	0.7	115	25.5	10,750
2017	7,009	2,809	808	179	7	0.5	50	22.6	10,885
2018	7,132	2,858	822	161	7	0.2	0.2	19.8	11,000
2019	7,255	2,907	836	143	7			17.0	11,165
2020	7,377	2,956	850	125	7			16.1	11,332
2021	7,500	3,005	865	107	7			13.5	11,497
2022	7,622	3,054	879	90	7			10.3	11,662
2023	7,745	3,104	893	72	7			7.0	11,828
2024	7,868	3,153	907	54	7			3.2	11,992
2025	7,990	3,202	921	36	8				12,157
2026	8,113	3,251	935	18	8				12,325
2027	8,235	3,300	949		8				12,492
2028	8,358	3,349	963		8				12,678
2029	8,480	3,398	978		8				12,864
2030	8,603	3,447	992		8				13,050
2031	8,735	3,500	1,007		8				13,250
2032	8,866	3,553	1,022		9				13,450
2033	8,998	3,606	1,037		9				13,650
2034	9,129	3,658	1,052		9				13,849
2035	9,261	3,711	1,068		9				14,049
2036	9,393	3,764	1,083		9				14,248
2037	9,524	3,817	1,098		9				14,448
2038	9,656	3,869	1,113		9				14,647
2039	9,787	3,922	1,128		9				14,847
2040	9,919	3,975	1,143		10				15,047
2041	10,021	4,016	1,155		10				15,202
2042	10,123	4,056	1,167		10				15,355
2043	10,224	4,097	1,179		10				15,510
2044	10,326	4,138	1,190		10				15,664
2045	10,428	4,179	1,202		10				15,819
2046	10,529	4,219	1,214		10				15,972
2047	10,631	4,260	1,226		10				16,127
2048	10,733	4,301	1,237		10				16,281
2049	10,835	4,342	1,249		11				16,436
2050	10,936	4,382	1,261		11				16,590
2051	11,027	4,419	1,271		11				16,728
2052	11,118	4,456	1,282		11				16,867
2053	11,210	4,492	1,292		11				17,005
2054	11,301	4,529	1,303		11				17,143
2055	11,392	4,565	1,313		11				17,281
2056	11,483	4,602	1,324		11				17,420
2057	11,574	4,638	1,334		11				17,558
2058	11,665	4,675	1,345		11				17,696
2059	11,756	4,711	1,355		11				17,834
2060	11,847	4,748	1,366		12				17,973
2061	11,955	4,791	1,378		12				18,136
2062	12,063	4,834	1,391		12				18,299
2063	12,171	4,877	1,403		12				18,463
2064	12,279	4,920	1,415		12				18,626
2065	12,386	4,964	1,428		12				18,790
2066	12,494	5,007	1,440		12				18,954
2067	12,602	5,050	1,453		12				19,117
2068	12,710	5,093	1,465		12				19,280
2069	12,818	5,136	1,478		13				19,444
2070	12,925	5,180	1,490		13				19,608

Table 5-2. Savings for Single-family Residential Activities (MG).

Year	Free Toilet Voucher Program	HE Toilet Rebate (SF)	Clotheswasher Rebate (SF)	Free Irrigation System Efficiency Evaluation	Irrigation Upgrade Rebate	WaterWise Rebate	Showerhead Distribution	Bathroom + Kitchen Faucet Aerator Distribution	Soil Moisture Monitor Distribution	Tree Gator Distribution	Pool Cover Rebate	Hose Timer Rebate	Pressure Regulating Valve Rebate	TOTAL SAVINGS
2010	39.8	43.6	26.6	75.4	1.1	0.3	0.1	0.1	N/A				0.6	187.7
2011	87.9	43.6	41.3	157.0	2.5	2.2	3.9	1.8					1.1	341.3
2012	87.9	43.6	49.6	213.2	4.0	2.9	76.2	12.2		0.003	0.1	0.02	1.4	491.0
2013	87.9	43.6	55.0	177.6	4.4	5.6	90.4	36.4		0.3	0.1	0.07	1.7	503.1
2014	87.9	43.6	55.0	113.9	4.7	19.0	120.1	66.3		0.4	0.2	0.12	2.0	513.2
2015	87.9	43.6	55.0	95.2	3.9	25.2	123.3	70.7		0.5	0.3	0.14	2.3	508.0
2016	87.9	43.6	55.0	55.5	2.3	25.2	123.3	69.0		0.5	0.3	0.09	2.3	464.9
2017	87.9	43.6	55.0	37.5	0.7	25.2	123.3	58.6		0.5	0.3	0.04	2.3	434.9
2018	87.9	43.6	55.0			25.2	123.3	34.4		0.2	0.3		2.3	372.1
2019	87.9	43.6	55.0			25.2	123.3	4.5		0.1	0.3		2.3	342.1
2020	97.1	43.6	55.0			24.9	123.3				0.3		1.7	345.8
2021	108.2	43.6	55.0			23.0	123.3				0.3		1.2	354.6
2022	108.2	43.6	28.4			22.3	123.3				0.2		0.9	326.9
2023	108.2	43.6	13.7			19.6	123.3				0.2		0.6	309.1
2024	108.2	43.6	5.4			6.2	123.3				0.1		0.3	287.1
2025	108.2	43.6					123.3							275.1
2026	108.2	43.6					123.3							275.1
2027	108.2	43.6					123.3							275.1
2028	108.2	43.6					123.3							275.1
2029	108.2	43.6					123.3							275.1
2030	108.2	43.6					123.3							275.1
2031	108.2	43.6					123.3							275.1
2032	108.2	43.6					123.3							275.1
2033	108.2	43.6					123.3							275.1
2034	108.2	43.6					123.3							275.1
2035	108.2	43.6					123.3							275.1
2036	108.2	43.6					123.3							275.1
2037	108.2	43.6					123.3							275.1
2038	108.2	43.6					123.3							275.1
2039	108.2	43.6					123.3							275.1
2040	108.2	43.6					123.3							275.1
2041	108.2	43.6					123.3							275.1
2042	108.2	43.6					123.3							275.1
2043	108.2	43.6					123.3							275.1
2044	108.2	43.6					123.3							275.1
2045	108.2	43.6					123.3							275.1
2046	108.2	43.6					123.3							275.1
2047	108.2	43.6					123.3							275.1
2048	108.2	43.6					123.3							275.1
2049	108.2	43.6					123.3							275.1
2050	108.2	43.6					123.3							275.1
2051	108.2	43.6					123.3							275.1
2052	108.2	43.6					123.3							275.1
2053	108.2	43.6					123.3							275.1
2054	108.2	43.6					123.3							275.1
2055	108.2	43.6					123.3							275.1
2056	108.2	43.6					123.3							275.1
2057	108.2	43.6					123.3							275.1
2058	108.2	43.6					123.3							275.1
2059	108.2	43.6					123.3							275.1
2060	108.2	43.6					123.3							275.1
2061	108.2	43.6					123.3							275.1
2062	108.2	43.6					123.3							275.1
2063	108.2	43.6					123.3							275.1
2064	108.2	43.6					123.3							275.1
2065	108.2	43.6					123.3							275.1
2066	108.2	43.6					123.3							275.1
2067	108.2	43.6					123.3							275.1
2068	108.2	43.6					123.3							275.1
2069	108.2	43.6					123.3							275.1
2070	108.2	43.6					123.3							275.1

Table 5-3. Savings for Multi-family Residential Activities (MG).

Year	Free Toilet Voucher Program	HE Toilet Rebate (MF)	Clotheswasher Rebate (MF)	WaterWise Landscape Conversion Rebate	Pressure Regulating Valve Rebate	Showerhead Distribution	Bathroom + Kitchen Faucet Aerator Distribution	Soil Moisture Monitor Distribution	Tree Gator Distribution	TOTAL SAVINGS
2010	6.1	136.6	0	0	0			N/A	0	143
2011	11.3	136.6								148
2012	11.3	136.6								148
2013	11.3	136.6				2.8	3.0			154
2014	11.3	136.6				2.8	3.0			154
2015	11.3	136.6				7.3	8.8			164
2016	11.3	136.6				7.3	8.8			164
2017	11.3	136.6				7.3	8.8			164
2018	11.3	136.6				7.3	5.8			161
2019	11.3	136.6				7.3	5.8			161
2020	12.7	136.6				7.3				157
2021	13.9	136.6				7.3				158
2022	13.9	136.6				7.3				158
2023	13.9	136.6				7.3				158
2024	13.9	136.6				7.3				158
2025	13.9	136.6				7.3				158
2026	13.9	136.6				7.3				158
2027	13.9	136.6				7.3				158
2028	13.9	136.6				7.3				158
2029	13.9	136.6				7.3				158
2030	13.9	136.6				7.3				158
2031	13.9	136.6				7.3				158
2032	13.9	136.6				7.3				158
2033	13.9	136.6				7.3				158
2034	13.9	136.6				7.3				158
2035	13.9	136.6				7.3				158
2036	13.9	136.6				7.3				158
2037	13.9	136.6				7.3				158
2038	13.9	136.6				7.3				158
2039	13.9	136.6				7.3				158
2040	13.9	136.6				7.3				158
2041	13.9	136.6				7.3				158
2042	13.9	136.6				7.3				158
2043	13.9	136.6				7.3				158
2044	13.9	136.6				7.3				158
2045	13.9	136.6				7.3				158
2046	13.9	136.6				7.3				158
2047	13.9	136.6				7.3				158
2048	13.9	136.6				7.3				158
2049	13.9	136.6				7.3				158
2050	13.9	136.6				7.3				158
2051	13.9	136.6				7.3				158
2052	13.9	136.6				7.3				158
2053	13.9	136.6				7.3				158
2054	13.9	136.6				7.3				158
2055	13.9	136.6				7.3				158
2056	13.9	136.6				7.3				158
2057	13.9	136.6				7.3				158
2058	13.9	136.6				7.3				158
2059	13.9	136.6				7.3				158
2060	13.9	136.6				7.3				158
2061	13.9	136.6				7.3				158
2062	13.9	136.6				7.3				158
2063	13.9	136.6				7.3				158
2064	13.9	136.6				7.3				158
2065	13.9	136.6				7.3				158
2066	13.9	136.6				7.3				158
2067	13.9	136.6				7.3				158
2068	13.9	136.6				7.3				158
2069	13.9	136.6				7.3				158
2070	13.9	136.6				7.3				158

Table 5-4. Savings for ICI Activities (MG).

Year	Free Toilet Voucher Program	HE Toilet Rebate (ICI)	Clotheswasher Rebate (ICI)	Irrigation Controllers	Commercial Irrigation Rebate	ICI Audit	Commercial Kitchen Rebate	Commercial Process Rebate	Mandatory Commercial Facility Irrigation Assessment	Mandatory Commercial Vehicle Facility Efficiency Assessment	TOTAL SAVINGS
2010	1.4	5.8	0.2	1.4	0.0	0	0	Variable		N/A	9
2011	2.1	5.8	0.5	2.1							10
2012	2.1	5.8	2.3	2.9							13
2013	2.1	5.8	2.4	3.0					1		15
2014	2.1	5.8	2.4	3.0					188		202
2015	2.1	5.8	2.4	3.0					463		476
2016	2.1	5.8	2.4	3.0					461		475
2017	2.1	5.8	2.4	3.0					274		288
2018	2.1	5.8	2.2	3.0							13
2019	2.4	5.8	1.9	3.0							13
2020	2.5	5.8	0.1	1.6							10
2021	2.5	5.8		0.9							9
2022	2.5	5.8		0.1							8
2023	2.5	5.8									8
2024	2.5	5.8									8
2025	2.5	5.8									8
2026	2.5	5.8									8
2027	2.5	5.8									8
2028	2.5	5.8									8
2029	2.5	5.8									8
2030	2.5	5.8									8
2031	2.5	5.8									8
2032	2.5	5.8									8
2033	2.5	5.8									8
2034	2.5	5.8									8
2035	2.5	5.8									8
2036	2.5	5.8									8
2037	2.5	5.8									8
2038	2.5	5.8									8
2039	2.5	5.8									8
2040	2.5	5.8									8
2041	2.5	5.8									8
2042	2.5	5.8									8
2043	2.5	5.8									8
2044	2.5	5.8									8
2045	2.5	5.8									8
2046	2.5	5.8									8
2047	2.5	5.8									8
2048	2.5	5.8									8
2049	2.5	5.8									8
2050	2.5	5.8									8
2051	2.5	5.8									8
2052	2.5	5.8									8
2053	2.5	5.8									8
2054	2.5	5.8									8
2055	2.5	5.8									8
2056	2.5	5.8									8
2057	2.5	5.8									8
2058	2.5	5.8									8
2059	2.5	5.8									8
2060	2.5	5.8									8
2061	2.5	5.8									8
2062	2.5	5.8									8
2063	2.5	5.8									8
2064	2.5	5.8									8
2065	2.5	5.8									8
2066	2.5	5.8									8
2067	2.5	5.8									8
2068	2.5	5.8									8
2069	2.5	5.8									8
2070	2.5	5.8									8

Table 5-5. Savings from All Activities Not Including Water Loss Reduction (MG).

Year	Service Area-wide + Ordinance Activities	Single-family Activities	Multi-family Activities	ICI Activities	TOTAL ACTIVITY SAVINGS
2010	109	187.7	143	9	448
2011	198	341.3	148	10	698
2012	3,574	491.0	148	13	4,226
2013	6,289	503.1	154	15	6,960
2014	6,417	513.2	154	202	7,286
2015	6,854	508.0	164	476	8,002
2016	10,750	464.9	164	475	11,853
2017	10,885	434.9	164	288	11,772
2018	11,000	372.1	161	13	11,546
2019	11,165	342.1	161	13	11,681
2020	11,332	345.8	157	10	11,844
2021	11,497	354.6	158	9	12,019
2022	11,662	326.9	158	8	12,155
2023	11,828	309.1	158	8	12,303
2024	11,992	287.1	158	8	12,445
2025	12,157	275.1	158	8	12,598
2026	12,325	275.1	158	8	12,766
2027	12,492	275.1	158	8	12,934
2028	12,678	275.1	158	8	13,120
2029	12,864	275.1	158	8	13,305
2030	13,050	275.1	158	8	13,491
2031	13,250	275.1	158	8	13,691
2032	13,450	275.1	158	8	13,891
2033	13,650	275.1	158	8	14,091
2034	13,849	275.1	158	8	14,290
2035	14,049	275.1	158	8	14,490
2036	14,248	275.1	158	8	14,690
2037	14,448	275.1	158	8	14,890
2038	14,647	275.1	158	8	15,089
2039	14,847	275.1	158	8	15,289
2040	15,047	275.1	158	8	15,488
2041	15,202	275.1	158	8	15,643
2042	15,355	275.1	158	8	15,797
2043	15,510	275.1	158	8	15,951
2044	15,664	275.1	158	8	16,106
2045	15,819	275.1	158	8	16,260
2046	15,972	275.1	158	8	16,414
2047	16,127	275.1	158	8	16,568
2048	16,281	275.1	158	8	16,723
2049	16,436	275.1	158	8	16,877
2050	16,590	275.1	158	8	17,031
2051	16,728	275.1	158	8	17,170
2052	16,867	275.1	158	8	17,308
2053	17,005	275.1	158	8	17,446
2054	17,143	275.1	158	8	17,585
2055	17,281	275.1	158	8	17,722
2056	17,420	275.1	158	8	17,861
2057	17,558	275.1	158	8	17,999
2058	17,696	275.1	158	8	18,138
2059	17,834	275.1	158	8	18,275
2060	17,973	275.1	158	8	18,414
2061	18,136	275.1	158	8	18,577
2062	18,299	275.1	158	8	18,741
2063	18,463	275.1	158	8	18,904
2064	18,626	275.1	158	8	19,067
2065	18,790	275.1	158	8	19,232
2066	18,954	275.1	158	8	19,395
2067	19,117	275.1	158	8	19,558
2068	19,280	275.1	158	8	19,722
2069	19,444	275.1	158	8	19,885
2070	19,608	275.1	158	8	20,049

Table 5-6. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	904,351	17.27	0
2015	926,624	20.00	(923)
2016	951,497	17.00	94
2017	976,371	17.00	96
2018	1,001,244	17.00	99
2019	1,026,118	17.00	101
2020	1,050,991	17.00	104
2021	1,072,217	17.00	106
2022	1,093,444	17.00	108
2023	1,114,670	17.00	110
2024	1,135,896	17.00	112

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015).
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	11,853	94	11,947	673	4,159	0	4,159	8,461
2017	11,772	96	11,868	685	4,159	0	4,159	8,394
2018	11,546	99	11,645	697	4,990	0	4,990	7,352
2019	11,681	101	11,782	709	5,822	0	5,822	6,669
2020	11,844	104	11,948	721	7,486	0	7,486	5,184
2021	12,019	106	12,125	733	7,537	0	7,537	5,320
2022	12,155	108	12,263	745	7,589	0	7,589	5,419
2023	12,303	110	12,413	757	7,641	0	7,641	5,529
2024	12,445	112	12,557	769	7,693	0	7,693	5,633
2025	12,598	114	12,712	781	7,745	0	7,745	5,748
2026	12,766	116	12,882	793	7,797	0	7,797	5,879
2027	12,934	118	13,052	805	7,848	0	7,848	6,009
2028	13,120	120	13,240	817	7,900	0	7,900	6,157
2029	13,305	122	13,428	829	7,952	0	7,952	6,305
2030	13,491	124	13,616	841	8,004	0	8,004	6,453
2031	13,691	127	13,818	854	8,126	0	8,126	6,546
2032	13,891	129	14,020	867	8,249	0	8,249	6,638
2033	14,091	131	14,222	880	8,371	0	8,371	6,730
2034	14,290	133	14,423	893	8,494	0	8,494	6,822
2035	14,490	135	14,625	905	8,616	0	8,616	6,914
2036	14,690	137	14,827	918	8,739	0	8,739	7,007
2037	14,890	139	15,029	931	8,861	0	8,861	7,099
2038	15,089	141	15,230	944	8,984	0	8,984	7,190
2039	15,289	143	15,432	957	9,106	0	9,106	7,283
2040	15,488	146	15,634	970	9,229	0	9,229	7,375

Statewide Water Conservation Quantification Project
Aqua WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Aqua WSC's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Aqua WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Aqua WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Aqua WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	72	(119)	(47)	102	0	102	(149)
2016	74	(120)	(46)	127	0	127	(173)
2017	77	(121)	(44)	127	0	127	(172)
2018	79	(122)	(43)	153	0	153	(196)
2019	81	(122)	(41)	178	0	178	(220)
2020	83	(123)	(40)	229	0	229	(270)
2021	85	(127)	(42)	239	0	239	(281)
2022	87	(131)	(44)	249	0	249	(293)
2023	89	(135)	(45)	259	0	259	(304)
2024	92	(139)	(47)	269	0	269	(316)
2025	94	(142)	(49)	279	0	279	(327)
2026	96	(146)	(51)	288	0	288	(339)
2027	98	(150)	(52)	298	0	298	(351)
2028	100	(154)	(54)	308	0	308	(362)
2029	102	(158)	(56)	318	0	318	(374)
2030	104	(162)	(57)	328	0	328	(385)
2031	107	(167)	(60)	330	0	330	(390)
2032	110	(172)	(62)	332	0	332	(394)
2033	113	(177)	(64)	334	0	334	(398)
2034	115	(182)	(67)	336	0	336	(402)
2035	118	(187)	(69)	338	0	338	(406)
2036	121	(192)	(71)	340	0	340	(411)
2037	124	(197)	(73)	342	0	342	(415)
2038	126	(202)	(76)	343	0	343	(419)
2039	129	(207)	(78)	345	0	345	(423)
2040	132	(212)	(80)	347	0	347	(428)
2041	136	(219)	(83)	353	0	353	(436)
2042	140	(226)	(86)	358	0	358	(445)
2043	143	(233)	(89)	364	0	364	(453)
2044	147	(240)	(92)	369	0	369	(462)
2045	151	(246)	(95)	375	0	375	(470)
2046	155	(253)	(99)	380	0	380	(479)
2047	158	(260)	(102)	386	0	386	(488)
2048	162	(267)	(105)	391	0	391	(496)
2049	166	(274)	(108)	397	0	397	(505)
2050	170	(280)	(111)	402	0	402	(513)
2051	175	(290)	(115)	415	0	415	(530)
2052	180	(299)	(119)	428	0	428	(547)
2053	185	(308)	(123)	440	0	440	(564)
2054	190	(317)	(127)	453	0	453	(580)
2055	195	(327)	(131)	466	0	466	(597)
2056	200	(336)	(136)	478	0	478	(614)
2057	205	(345)	(140)	491	0	491	(631)
2058	210	(354)	(144)	504	0	504	(647)
2059	215	(363)	(148)	516	0	516	(664)
2060	221	(373)	(152)	529	0	529	(681)
2061	227	(385)	(158)	545	0	545	(703)
2062	234	(397)	(163)	562	0	562	(725)
2063	241	(409)	(169)	579	0	579	(747)
2064	247	(422)	(174)	595	0	595	(769)
2065	254	(434)	(180)	612	0	612	(791)
2066	261	(446)	(185)	628	0	628	(813)
2067	268	(458)	(191)	645	0	645	(836)
2068	274	(471)	(196)	661	0	661	(858)
2069	281	(483)	(202)	678	0	678	(880)
2070	288	(495)	(208)	694	0	694	(902)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Aqua WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	132	0	1	1
1	2015	54,500	130	32	(47)	(79)
2	2016	54,839	129	64	(46)	(110)
3	2017	55,178	127	97	(44)	(141)
4	2018	55,516	126	130	(43)	(173)
5-year Goal	2019	55,855	124	163	(41)	(205)
6	2020	56,194	124	172	(40)	(212)
7	2021	57,964	123	186	(42)	(228)
8	2022	59,734	123	201	(44)	(244)
9	2023	61,503	122	216	(45)	(261)
10-year Goal	2024	63,273	122	231	(47)	(278)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Aqua WSC's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	25.00	0	0	0
1	2015	54,500	24.40	12	(119)	(131)
2	2016	54,839	23.80	24	(120)	(144)
3	2017	55,178	23.20	36	(121)	(157)
4	2018	55,516	22.60	49	(122)	(170)
5-year Goal	2019	55,855	22.00	61	(122)	(183)
6	2020	56,194	21.40	74	(123)	(197)
7	2021	57,964	20.80	89	(127)	(216)
8	2022	59,734	20.20	105	(131)	(235)
9	2023	61,503	19.60	121	(135)	(256)
10-year Goal	2024	63,273	19.00	139	(139)	(277)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 119 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 10.0% increase in 2011
        ii. 1.5% increase in 2014
    b. Estimated customer demand reduction of 2.3%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future year.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011	63.8	64
2012	65.9	66
2013	68.1	68
2014	70.2	70
2015	72.3	72
2016	74.5	74
2017	76.6	77
2018	78.7	79
2019	80.9	81
2020	83.0	83
2021	85.1	85
2022	87.3	87
2023	89.4	89
2024	91.5	92
2025	93.7	94
2026	95.8	96
2027	97.9	98
2028	100.1	100
2029	102.2	102
2030	104.3	104
2031	107.1	107
2032	109.9	110
2033	112.6	113
2034	115.4	115
2035	118.2	118
2036	120.9	121
2037	123.7	124
2038	126.5	126
2039	129.3	129
2040	132.0	132
2041	135.8	136
2042	139.6	140
2043	143.3	143
2044	147.1	147
2045	150.9	151
2046	154.6	155
2047	158.4	158
2048	162.2	162
2049	165.9	166
2050	169.7	170
2051	174.8	175
2052	179.9	180
2053	185.0	185
2054	190.1	190
2055	195.1	195
2056	200.2	200
2057	205.3	205
2058	210.4	210
2059	215.5	215
2060	220.6	221
2061	227.3	227
2062	234.0	234
2063	240.7	241
2064	247.4	247
2065	254.1	254
2066	260.8	261
2067	267.5	268
2068	274.2	274
2069	280.9	281
2070	287.6	288

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	25.00	0
2015	54,500	31.00	(119)
2016	54,839	31.00	(120)
2017	55,178	31.00	(121)
2018	55,516	31.00	(122)
2019	55,855	31.00	(122)
2020	56,194	31.00	(123)
2021	57,964	31.00	(127)
2022	59,734	31.00	(131)
2023	61,503	31.00	(135)
2024	63,273	31.00	(139)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 6.53% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region K savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 211 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	74	(120)	(46)	211	127	0	127	38
2017	77	(121)	(44)	217	127	0	127	46
2018	79	(122)	(43)	224	153	0	153	28
2019	81	(122)	(41)	230	178	0	178	10
2020	83	(123)	(40)	236	229	0	229	(34)
2021	85	(127)	(42)	242	239	0	239	(39)
2022	87	(131)	(44)	248	249	0	249	(45)
2023	89	(135)	(45)	254	259	0	259	(50)
2024	92	(139)	(47)	260	269	0	269	(56)
2025	94	(142)	(49)	266	279	0	279	(62)
2026	96	(146)	(51)	272	288	0	288	(67)
2027	98	(150)	(52)	278	298	0	298	(73)
2028	100	(154)	(54)	284	308	0	308	(78)
2029	102	(158)	(56)	290	318	0	318	(84)
2030	104	(162)	(57)	296	328	0	328	(89)
2031	107	(167)	(60)	304	330	0	330	(85)
2032	110	(172)	(62)	312	332	0	332	(82)
2033	113	(177)	(64)	320	334	0	334	(78)
2034	115	(182)	(67)	328	336	0	336	(75)
2035	118	(187)	(69)	336	338	0	338	(71)
2036	121	(192)	(71)	343	340	0	340	(67)
2037	124	(197)	(73)	351	342	0	342	(64)
2038	126	(202)	(76)	359	343	0	343	(60)
2039	129	(207)	(78)	367	345	0	345	(56)
2040	132	(212)	(80)	375	347	0	347	(53)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	74	(120)	(46)	43	127	0	127	(130)
2017	77	(121)	(44)	45	127	0	127	(127)
2018	79	(122)	(43)	46	153	0	153	(150)
2019	81	(122)	(41)	47	178	0	178	(173)
2020	83	(123)	(40)	48	229	0	229	(221)
2021	85	(127)	(42)	50	239	0	239	(231)
2022	87	(131)	(44)	51	249	0	249	(242)
2023	89	(135)	(45)	52	259	0	259	(252)
2024	92	(139)	(47)	53	269	0	269	(263)
2025	94	(142)	(49)	55	279	0	279	(273)
2026	96	(146)	(51)	56	288	0	288	(283)
2027	98	(150)	(52)	57	298	0	298	(294)
2028	100	(154)	(54)	58	308	0	308	(304)
2029	102	(158)	(56)	60	318	0	318	(314)
2030	104	(162)	(57)	61	328	0	328	(325)
2031	107	(167)	(60)	62	330	0	330	(327)
2032	110	(172)	(62)	64	332	0	332	(330)
2033	113	(177)	(64)	66	334	0	334	(332)
2034	115	(182)	(67)	67	336	0	336	(335)
2035	118	(187)	(69)	69	338	0	338	(338)
2036	121	(192)	(71)	70	340	0	340	(340)
2037	124	(197)	(73)	72	342	0	342	(343)
2038	126	(202)	(76)	74	343	0	343	(345)
2039	129	(207)	(78)	75	345	0	345	(348)
2040	132	(212)	(80)	77	347	0	347	(351)

3. Rain Barrels
    a. In Region K, utilities could save approximately 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Horseshoe Bay Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Horseshoe Bay's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Horseshoe Bay's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Horseshoe Bay's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Horseshoe Bay with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	52	19	72	38	0	38	33
2016	80	20	100	48	0	48	52
2017	81	20	101	48	0	48	53
2018	81	21	102	57	0	57	44
2019	82	21	103	67	0	67	36
2020	83	21	104	86	0	86	18
2021	83	22	106	95	0	95	10
2022	84	23	107	105	0	105	2
2023	85	24	109	114	0	114	(6)
2024	86	24	110	124	0	124	(13)
2025	87	25	112	133	0	133	(21)
2026	88	26	114	143	0	143	(29)
2027	89	27	115	152	0	152	(37)
2028	89	27	117	162	0	162	(45)
2029	90	28	118	171	0	171	(53)
2030	91	29	120	181	0	181	(61)
2031	92	30	121	190	0	190	(69)
2032	92	31	123	200	0	200	(77)
2033	93	32	124	210	0	210	(85)
2034	93	33	126	219	0	219	(93)
2035	94	34	127	229	0	229	(102)
2036	94	35	129	239	0	239	(110)
2037	95	36	131	249	0	249	(118)
2038	95	37	132	258	0	258	(126)
2039	96	38	134	268	0	268	(134)
2040	96	39	135	278	0	278	(143)
2041	97	40	137	288	0	288	(151)
2042	97	41	139	298	0	298	(159)
2043	98	43	140	307	0	307	(167)
2044	98	44	142	317	0	317	(175)
2045	99	45	144	327	0	327	(183)
2046	99	47	146	337	0	337	(192)
2047	100	48	148	347	0	347	(200)
2048	100	49	149	357	0	357	(208)
2049	100	51	151	367	0	367	(216)
2050	101	52	153	377	0	377	(224)
2051	102	53	155	388	0	388	(233)
2052	102	55	157	399	0	399	(243)
2053	103	56	159	411	0	411	(252)
2054	103	57	161	422	0	422	(261)
2055	104	59	163	433	0	433	(271)
2056	105	60	164	444	0	444	(280)
2057	105	61	166	456	0	456	(289)
2058	106	63	168	467	0	467	(298)
2059	106	64	170	478	0	478	(308)
2060	107	65	172	489	0	489	(317)
2061	108	67	174	500	0	500	(326)
2062	108	68	176	511	0	511	(335)
2063	109	69	178	522	0	522	(344)
2064	109	71	180	533	0	533	(353)
2065	110	72	182	544	0	544	(363)
2066	110	73	184	555	0	555	(372)
2067	111	75	185	566	0	566	(381)
2068	111	76	187	577	0	577	(390)
2069	112	77	189	588	0	588	(399)
2070	112	79	191	599	0	599	(408)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Horseshoe Bay's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	217	0	0	0
1	2015	7,589	210	19	72	52
2	2016	7,747	203	40	101	61
3	2017	7,905	196	61	102	41
4	2018	8,062	189	82	103	20
5-year Goal	2019	8,220	182	105	104	(1)
6	2020	8,378	180	112	105	(7)
7	2021	8,666	179	121	107	(14)
8	2022	8,954	177	130	108	(22)
9	2023	9,243	176	140	110	(30)
10-year Goal	2024	9,531	174	150	111	(38)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Horseshoe Bay's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	7,589	14.40	2	19	18
2	2016	7,747	13.80	3	20	16
3	2017	7,905	13.20	5	20	15
4	2018	8,062	12.60	7	21	14
5-year Goal	2019	8,220	12.00	9	21	12
6	2020	8,378	11.60	10	21	11
7	2021	8,666	11.20	12	22	10
8	2022	8,954	10.80	14	23	9
9	2023	9,243	10.40	16	24	8
10-year Goal	2024	9,531	10.00	17	24	7

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 19 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 1.8% increase in 2015
        ii. 4.9% increase in 2016
    b. Estimated customer demand reduction of 1.35%
    c. Savings are cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 6.53% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

7. Outdoor landscape evaluations for single family (SF) customers

a. 127 outdoor evaluations performed since 2014
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
    i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. Rain Barrels

a. In Region K, estimated savings of 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
b. Estimated 10-year useful life for most barrels

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Water Rate Increase	Outdoor Residential Survey	2x Watering Ordinance	TOTAL SAVINGS
2012					0
2013					0
2014			0.5		0.5
2015	0.01		0.9	51.2	52
2016	0.01	27	0.7	52.0	80
2017	0.01	27	0.5	52.9	81
2018	0.01	27	0.3	53.7	81
2019	0.01	27	0.1	54.5	82
2020	0.01	27		55.4	83
2021	0.01	27		56.2	83
2022	0.01	27		57.0	84
2023	0.01	27		57.8	85
2024	0.01	27		58.7	86
2025		27		59.5	87
2026		27		60.3	88
2027		27		61.2	89
2028		27		62.0	89
2029		27		62.8	90
2030		27		63.7	91
2031		27		64.2	92
2032		27		64.7	92
2033		27		65.2	93
2034		27		65.8	93
2035		27		66.3	94
2036		27		66.8	94
2037		27		67.3	95
2038		28		67.8	95
2039		28		68.3	96
2040		28		68.9	96
2041		28		69.3	97
2042		28		69.7	97
2043		28		70.2	98
2044		28		70.6	98
2045		28		71.1	99
2046		28		71.5	99
2047		28		71.9	100
2048		28		72.4	100
2049		28		72.8	100
2050		28		73.3	101
2051		28		73.8	102
2052		28		74.4	102
2053		28		75.0	103
2054		28		75.6	103
2055		28		76.2	104
2056		28		76.8	105
2057		28		77.4	105
2058		28		78.0	106
2059		28		78.6	106
2060		28		79.2	107
2061		28		79.7	108
2062		28		80.2	108
2063		28		80.8	109
2064		28		81.3	109
2065		28		81.8	110
2066		28		82.4	110
2067		28		82.9	111
2068		28		83.5	111
2069		28		84.0	112
2070		28		84.5	112

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	7,589	8.00	19
2016	7,747	8.00	20
2017	7,905	8.00	20
2018	8,062	8.00	21
2019	8,220	8.00	21
2020	8,378	8.00	21
2021	8,666	8.00	22
2022	8,954	8.00	23
2023	9,243	8.00	24
2024	9,531	8.00	24

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	80	20	100	11	48	0	48	63
2017	81	20	101	11	48	0	48	64
2018	81	21	102	11	57	0	57	56
2019	82	21	103	11	67	0	67	47
2020	83	21	104	11	86	0	86	29
2021	83	22	106	12	95	0	95	22
2022	84	23	107	12	105	0	105	14
2023	85	24	109	12	114	0	114	6
2024	86	24	110	12	124	0	124	(1)
2025	87	25	112	12	133	0	133	(9)
2026	88	26	114	12	143	0	143	(17)
2027	89	27	115	13	152	0	152	(25)
2028	89	27	117	13	162	0	162	(32)
2029	90	28	118	13	171	0	171	(40)
2030	91	29	120	13	181	0	181	(48)
2031	92	30	121	13	190	0	190	(56)
2032	92	31	123	13	200	0	200	(64)
2033	93	32	124	13	210	0	210	(72)
2034	93	33	126	13	219	0	219	(80)
2035	94	34	127	14	229	0	229	(88)
2036	94	35	129	14	239	0	239	(96)
2037	95	36	131	14	249	0	249	(104)
2038	95	37	132	14	258	0	258	(112)
2039	96	38	134	14	268	0	268	(120)
2040	96	39	135	14	278	0	278	(128)

1. Employ efforts to maintain water loss volumes near baseline level or below.
2. In the future, as your utility finds water and/or wastewater service rate increases necessary, such pricing signals should continue to be effective in reducing demand.

Statewide Water Conservation Quantification Project
Johnson City Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Johnson City's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Johnson City's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Johnson City's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Johnson City with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	10	2.6	13	3	0	3	10
2016	10	2.8	13	3	0	3	10
2017	10	3.1	14	3	0	3	10
2018	11	3.3	14	4	0	4	10
2019	11	3.5	14	5	0	5	10
2020	11	3.7	15	6	0	6	9
2021	11	3.8	15	6	0	6	9
2022	11	3.9	15	7	0	7	9
2023	12	4.0	15	7	0	7	8
2024	12	4.0	16	7	0	7	8
2025	12	4.1	16	8	0	8	8
2026	12	4.2	16	8	0	8	8
2027	12	4.2	16	9	0	9	8
2028	12	4.3	17	9	0	9	8
2029	13	4.4	17	9	0	9	8
2030	13	4.5	17	10	0	10	7
2031	13	4.5	17	10	0	10	8
2032	13	4.5	18	10	0	10	8
2033	13	4.6	18	10	0	10	8
2034	13	4.6	18	10	0	10	8
2035	13	4.7	18	10	0	10	8
2036	13	4.7	18	10	0	10	8
2037	13	4.7	18	10	0	10	8
2038	14	4.8	18	10	0	10	9
2039	14	4.8	19	10	0	10	9
2040	14	4.9	19	10	0	10	9
2041	14	4.9	19	9	0	9	10
2042	14	4.9	19	8	0	8	11
2043	14	4.9	19	7	0	7	12
2044	14	5.0	19	6	0	6	13
2045	14	5.0	19	5	0	5	14
2046	14	5.0	19	4	0	4	15
2047	14	5.0	19	3	0	3	16
2048	14	5.0	19	2	0	2	17
2049	14	5.1	19	1	0	1	18
2050	14	5.1	19	0	0	0	19
2051	14	5.1	19	0	0	0	19
2052	14	5.1	20	0	0	0	20
2053	14	5.1	20	0	0	0	20
2054	14	5.1	20	0	0	0	20
2055	15	5.2	20	0	0	0	20
2056	15	5.2	20	0	0	0	20
2057	15	5.2	20	0	0	0	20
2058	15	5.2	20	0	0	0	20
2059	15	5.2	20	0	0	0	20
2060	15	5.2	20	0	0	0	20
2061	15	5.2	20	0	0	0	20
2062	15	5.2	20	0	0	0	20
2063	15	5.3	20	0	0	0	20
2064	15	5.3	20	0	0	0	20
2065	15	5.3	20	0	0	0	20
2066	15	5.3	20	0	0	0	20
2067	15	5.3	20	0	0	0	20
2068	15	5.3	20	0	0	0	20
2069	15	5.3	20	0	0	0	20
2070	15	5.3	20	0	0	0	20

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Johnson City's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	124	0	0	0
1	2016	1,544	123	1	13	12
2	2017	1,671	122	1	14	12
3	2018	1,799	120	2	14	12
4	2019	1,926	119	3	14	11
5-year Goal	2020	2,053	118	4	15	10
6	2021	2,092	117	5	15	10
7	2022	2,131	116	6	15	9
8	2023	2,169	116	7	15	9
9	2024	2,208	115	7	16	8
10-year Goal	2025	2,247	114	8	16	8

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Johnson City's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2016	1,544	11.60	0	2.6	2
2	2017	1,671	11.20	0	2.8	2
3	2018	1,799	10.80	1	3.1	2
4	2019	1,926	10.40	1	3.3	2
5-year Goal	2020	2,053	10.00	1	3.5	2
6	2021	2,092	9.60	2	3.7	2
7	2022	2,131	9.20	2	3.8	2
8	2023	2,169	8.80	3	3.9	1
9	2024	2,208	8.40	3	4.0	1
10-year Goal	2025	2,247	8.00	3	4.0	1

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 2.6 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 5.0% increase in 2014
    b. Estimated customer demand reduction of 1.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Twice-a-week Outdoor Watering Restriction Ordinance

a. Estimated savings of 6.53% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increases	TOTAL SAVINGS
2009		1.9	2
2010		1.9	2
2011		2.0	2
2012		3.0	3
2013		3.1	3
2014	6.8	3.1	10
2015	6.9	3.2	10
2016	7.0	3.2	10
2017	7.2	3.3	10
2018	7.3	3.3	11
2019	7.4	3.4	11
2020	7.5	3.5	11
2021	7.7	3.5	11
2022	7.8	3.6	11
2023	7.9	3.6	12
2024	8.0	3.7	12
2025	8.1	3.7	12
2026	8.3	3.8	12
2027	8.4	3.9	12
2028	8.5	3.9	12
2029	8.6	4.0	13
2030	8.7	4.0	13
2031	8.8	4.1	13
2032	8.9	4.1	13
2033	9.0	4.1	13
2034	9.0	4.1	13
2035	9.1	4.2	13
2036	9.2	4.2	13
2037	9.2	4.2	13
2038	9.3	4.3	14
2039	9.4	4.3	14
2040	9.4	4.3	14
2041	9.5	4.4	14
2042	9.5	4.4	14
2043	9.6	4.4	14
2044	9.6	4.4	14
2045	9.6	4.4	14
2046	9.7	4.4	14
2047	9.7	4.5	14
2048	9.7	4.5	14
2049	9.8	4.5	14
2050	9.8	4.5	14
2051	9.8	4.5	14
2052	9.9	4.5	14
2053	9.9	4.5	14
2054	9.9	4.6	14
2055	9.9	4.6	15
2056	10.0	4.6	15
2057	10.0	4.6	15
2058	10.0	4.6	15
2059	10.0	4.6	15
2060	10.1	4.6	15
2061	10.1	4.6	15
2062	10.1	4.6	15
2063	10.1	4.6	15
2064	10.1	4.7	15
2065	10.2	4.7	15
2066	10.2	4.7	15
2067	10.2	4.7	15
2068	10.2	4.7	15
2069	10.2	4.7	15
2070	10.2	4.7	15

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
2014	-	12	0
2015	1,417	7	2.6
2016	1,544	7	2.8
2017	1,671	7	3.1
2018	1,799	7	3.3
2019	1,926	7	3.5
2020	2,053	7	3.7
2021	2,092	7	3.8
2022	2,131	7	3.9
2023	2,169	7	4.0
2024	2,208	7	4.0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	10	3	13	1	3	0	3	11
2017	10	3	14	1	3	0	3	12
2018	11	3	14	1	4	0	4	12
2019	11	4	14	2	5	0	5	11
2020	11	4	15	2	6	0	6	10
2021	11	4	15	2	6	0	6	10
2022	11	4	15	2	7	0	7	10
2023	12	4	15	2	7	0	7	10
2024	12	4	16	2	7	0	7	10
2025	12	4	16	2	8	0	8	10
2026	12	4	16	2	8	0	8	10
2027	12	4	16	2	9	0	9	10
2028	12	4	17	2	9	0	9	9
2029	13	4	17	2	9	0	9	9
2030	13	4	17	2	10	0	10	9
2031	13	4	17	2	10	0	10	9
2032	13	5	18	2	10	0	10	10
2033	13	5	18	2	10	0	10	10
2034	13	5	18	2	10	0	10	10
2035	13	5	18	2	10	0	10	10
2036	13	5	18	2	10	0	10	10
2037	13	5	18	2	10	0	10	10
2038	14	5	18	2	10	0	10	11
2039	14	5	19	2	10	0	10	11
2040	14	5	19	2	10	0	10	11

2. Rain Barrels
    a. In Region K, utilities could save approximately 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Llano Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Llano's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Llano's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Llano's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8][9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Llano with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	7	16	23	13	0	13	10
2016	7	16	23	16	0	16	7
2017	7	16	23	16	0	16	7
2018	7	16	23	19	0	19	4
2019	7	17	24	22	0	22	1
2020	7	17	24	29	0	29	(5)
2021	7	17	24	30	0	30	(6)
2022	7	17	24	31	0	31	(6)
2023	7	17	24	32	0	32	(7)
2024	7	17	24	33	0	33	(8)
2025	7	17	25	34	0	34	(9)
2026	7	17	25	35	0	35	(10)
2027	7	18	25	36	0	36	(11)
2028	7	18	25	37	0	37	(12)
2029	7	18	25	37	0	37	(12)
2030	7	18	25	38	0	38	(13)
2031	7	18	25	39	0	39	(14)
2032	7	18	25	40	0	40	(15)
2033	7	18	25	41	0	41	(16)
2034	7	18	25	42	0	42	(17)
2035	7	18	25	43	0	43	(17)
2036	7	18	25	43	0	43	(18)
2037	7	18	25	44	0	44	(19)
2038	7	18	25	45	0	45	(20)
2039	7	18	25	46	0	46	(21)
2040	7	18	25	47	0	47	(22)
2041	7	18	25	47	0	47	(23)
2042	7	18	25	48	0	48	(23)
2043	7	18	25	49	0	49	(24)
2044	7	18	25	50	0	50	(25)
2045	7	18	25	51	0	51	(26)
2046	7	18	25	52	0	52	(27)
2047	7	18	25	53	0	53	(28)
2048	7	18	25	53	0	53	(29)
2049	7	18	25	54	0	54	(30)
2050	7	18	24	55	0	55	(31)
2051	7	18	25	56	0	56	(32)
2052	7	18	25	58	0	58	(33)
2053	7	18	25	59	0	59	(34)
2054	7	18	25	60	0	60	(35)
2055	7	18	25	62	0	62	(37)
2056	7	18	25	63	0	63	(38)
2057	7	18	25	64	0	64	(39)
2058	7	18	25	66	0	66	(40)
2059	7	18	25	67	0	67	(42)
2060	7	18	25	68	0	68	(43)
2061	7	18	25	70	0	70	(44)
2062	7	18	25	71	0	71	(45)
2063	7	18	26	72	0	72	(47)
2064	7	18	26	74	0	74	(48)
2065	7	18	26	75	0	75	(49)
2066	7	18	26	77	0	77	(51)
2067	7	19	26	78	0	78	(52)
2068	7	19	26	79	0	79	(53)
2069	7	19	26	81	0	81	(55)
2070	7	19	26	82	0	82	(56)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Llano's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	216	0	0	0
1	2015	3,341	214	3	23	20
2	2016	3,386	212	5	23	18
3	2017	3,431	209	8	23	15
4	2018	3,475	207	11	23	12
5-year Goal	2019	3,520	205	14	24	10
6	2020	3,565	203	17	24	7
7	2021	3,584	201	20	24	4
8	2022	3,604	198	23	24	1
9	2023	3,623	196	26	24	(2)
10-year Goal	2024	3,643	194	29	24	(5)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Llano's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	27.00	0	0	0
1	2015	3,341	26.40	1	16	15
2	2016	3,386	25.80	1	16	15
3	2017	3,431	25.20	2	16	14
4	2018	3,475	24.60	3	16	13
5-year Goal	2019	3,520	24.00	4	17	13
6	2020	3,565	23.20	5	17	12
7	2021	3,584	22.40	6	17	11
8	2022	3,604	21.60	7	17	10
9	2023	3,623	20.80	8	17	9
10-year Goal	2024	3,643	20.00	9	17	8

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 15.9 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing and Water Rate Increases**
   a. Tiered rate structure in place saves approximately 2.5% of total demand
   b. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **Outdoor Landscape Evaluations (SF) with Indoor Component**
    a. 12 outdoor evaluations performed since 2013
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods

        20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Irrigation Audits	Conservation Pricing	TOTAL SAVINGS
2009	0.14	6.8	6.9
2010	0.16	6.8	6.9
2011	0.15	6.8	6.9
2012	0.15	6.8	7.0
2013	0.15	6.9	7.0
2014	0.14	6.9	7.0
2015	0.14	6.9	7.0
2016	0.10	6.9	7.0
2017	0.06	6.9	7.0
2018	0.03	7.0	7.0
2019	0.01	7.0	7.0
2020	0	7.0	7.0
2021	0	7.0	7.0
2022	0	7.1	7.1
2023	0	7.1	7.1
2024	0	7.1	7.1
2025	0	7.1	7.1
2026	0	7.2	7.2
2027	0	7.2	7.2
2028	0	7.2	7.2
2029	0	7.2	7.2
2030	0	7.3	7.3
2031	0	7.3	7.3
2032	0	7.2	7.2
2033	0	7.2	7.2
2034	0	7.2	7.2
2035	0	7.2	7.2
2036	0	7.2	7.2
2037	0	7.2	7.2
2038	0	7.2	7.2
2039	0	7.2	7.2
2040	0	7.2	7.2
2041	0	7.1	7.1
2042	0	7.1	7.1
2043	0	7.1	7.1
2044	0	7.1	7.1
2045	0	7.1	7.1
2046	0	7.0	7.0
2047	0	7.0	7.0
2048	0	7.0	7.0
2049	0	7.0	7.0
2050	0	7.0	7.0
2051	0	7.0	7.0
2052	0	7.0	7.0
2053	0	7.0	7.0
2054	0	7.1	7.1
2055	0	7.1	7.1
2056	0	7.1	7.1
2057	0	7.1	7.1
2058	0	7.2	7.2
2059	0	7.2	7.2
2060	0	7.2	7.2
2061	0	7.2	7.2
2062	0	7.2	7.2
2063	0	7.3	7.3
2064	0	7.3	7.3
2065	0	7.3	7.3
2066	0	7.3	7.3
2067	0	7.4	7.4
2068	0	7.4	7.4
2069	0	7.4	7.4
2070	0	7.4	7.4

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	27.00	0
2015	3,341	14.00	15.9
2016	3,386	14.00	16.1
2017	3,431	14.00	16.3
2018	3,475	14.00	16.5
2019	3,520	14.00	16.7
2020	3,565	14.00	16.9
2021	3,584	14.00	17.0
2022	3,604	14.00	17.1
2023	3,623	14.00	17.2
2024	3,643	14.00	17.3

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 6.53% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region K savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 18 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	16	23	18	16	0	16	25
2017	7	16	23	18	16	0	16	26
2018	7	16	23	18	19	0	19	23
2019	7	17	24	18	22	0	22	20
2020	7	17	24	18	29	0	29	14
2021	7	17	24	18	30	0	30	13
2022	7	17	24	18	31	0	31	12
2023	7	17	24	19	32	0	32	11
2024	7	17	24	19	33	0	33	10
2025	7	17	25	19	34	0	34	10
2026	7	17	25	19	35	0	35	9
2027	7	18	25	19	36	0	36	8
2028	7	18	25	19	37	0	37	7
2029	7	18	25	19	37	0	37	6
2030	7	18	25	19	38	0	38	6
2031	7	18	25	19	39	0	39	5
2032	7	18	25	19	40	0	40	4
2033	7	18	25	19	41	0	41	3
2034	7	18	25	19	42	0	42	2
2035	7	18	25	19	43	0	43	1
2036	7	18	25	19	43	0	43	0
2037	7	18	25	19	44	0	44	(0)
2038	7	18	25	19	45	0	45	(1)
2039	7	18	25	19	46	0	46	(2)
2040	7	18	25	19	47	0	47	(3)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	16	23	4	16	0	16	11
2017	7	16	23	4	16	0	16	11
2018	7	16	23	4	19	0	19	8
2019	7	17	24	4	22	0	22	5
2020	7	17	24	4	29	0	29	(1)
2021	7	17	24	4	30	0	30	(2)
2022	7	17	24	4	31	0	31	(3)
2023	7	17	24	4	32	0	32	(4)
2024	7	17	24	4	33	0	33	(4)
2025	7	17	25	4	34	0	34	(5)
2026	7	17	25	4	35	0	35	(6)
2027	7	18	25	4	36	0	36	(7)
2028	7	18	25	4	37	0	37	(8)
2029	7	18	25	4	37	0	37	(9)
2030	7	18	25	4	38	0	38	(9)
2031	7	18	25	4	39	0	39	(10)
2032	7	18	25	4	40	0	40	(11)
2033	7	18	25	4	41	0	41	(12)
2034	7	18	25	4	42	0	42	(13)
2035	7	18	25	4	43	0	43	(14)
2036	7	18	25	4	43	0	43	(14)
2037	7	18	25	4	44	0	44	(15)
2038	7	18	25	4	45	0	45	(16)
2039	7	18	25	4	46	0	46	(17)
2040	7	18	25	4	47	0	47	(18)

3. Water Rate Increase
   - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
   - **b.** Approximately 6 MG of savings per year with current demand
   - **c.** Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
   - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	16	23	6	16	0	16	13
2017	7	16	23	6	16	0	16	13
2018	7	16	23	6	19	0	19	10
2019	7	17	24	6	22	0	22	7
2020	7	17	24	6	29	0	29	1
2021	7	17	24	6	30	0	30	0
2022	7	17	24	6	31	0	31	(1)
2023	7	17	24	6	32	0	32	(2)
2024	7	17	24	6	33	0	33	(2)
2025	7	17	25	6	34	0	34	(3)
2026	7	17	25	6	35	0	35	(4)
2027	7	18	25	6	36	0	36	(5)
2028	7	18	25	6	37	0	37	(6)
2029	7	18	25	6	37	0	37	(7)
2030	7	18	25	6	38	0	38	(8)
2031	7	18	25	6	39	0	39	(8)
2032	7	18	25	6	40	0	40	(9)
2033	7	18	25	6	41	0	41	(10)
2034	7	18	25	6	42	0	42	(11)
2035	7	18	25	6	43	0	43	(12)
2036	7	18	25	6	43	0	43	(13)
2037	7	18	25	6	44	0	44	(13)
2038	7	18	25	6	45	0	45	(14)
2039	7	18	25	6	46	0	46	(15)
2040	7	18	25	6	47	0	47	(16)

4. Rain Barrels
   a. In Region K, utilities could save approximately 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Pflugerville Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Pflugerville's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Pflugerville's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Pflugerville's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Pflugerville with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	366	0	366	87	0	87	279
2016	381	0	381	109	0	109	272
2017	395	0	395	109	0	109	286
2018	409	0	409	131	0	131	278
2019	423	0	423	153	0	153	270
2020	437	0	437	197	0	197	240
2021	451	0	451	246	0	246	205
2022	465	0	465	295	0	295	171
2023	479	0	479	344	0	344	135
2024	493	0	493	393	0	393	100
2025	507	0	507	441	0	441	65
2026	520	0	520	490	0	490	30
2027	535	0	535	539	0	539	(5)
2028	549	0	549	588	0	588	(39)
2029	563	0	563	637	0	637	(74)
2030	577	0	577	686	0	686	(109)
2031	590	0	590	703	0	703	(112)
2032	604	0	604	720	0	720	(116)
2033	618	0	618	737	0	737	(119)
2034	631	0	631	754	0	754	(123)
2035	645	0	645	771	0	771	(126)
2036	658	0	658	788	0	788	(130)
2037	672	0	672	805	0	805	(133)
2038	685	0	685	822	0	822	(136)
2039	699	0	699	839	0	839	(140)
2040	712	0	712	855	0	855	(143)
2041	727	0	727	869	0	869	(141)
2042	743	0	743	882	0	882	(139)
2043	758	0	758	895	0	895	(137)
2044	773	0	773	908	0	908	(135)
2045	788	0	788	921	0	921	(133)
2046	803	0	803	934	0	934	(131)
2047	819	0	819	948	0	948	(129)
2048	834	0	834	961	0	961	(127)
2049	849	0	849	974	0	974	(125)
2050	864	0	864	987	0	987	(123)
2051	878	0	878	1,003	0	1,003	(125)
2052	891	0	891	1,019	0	1,019	(128)
2053	905	0	905	1,035	0	1,035	(130)
2054	918	0	918	1,050	0	1,050	(132)
2055	932	0	932	1,066	0	1,066	(135)
2056	945	0	945	1,082	0	1,082	(137)
2057	958	0	958	1,098	0	1,098	(139)
2058	972	0	972	1,114	0	1,114	(142)
2059	985	0	985	1,129	0	1,129	(144)
2060	999	0	999	1,145	0	1,145	(146)
2061	1,011	0	1,011	1,160	0	1,160	(148)
2062	1,024	0	1,024	1,175	0	1,175	(151)
2063	1,037	0	1,037	1,189	0	1,189	(153)
2064	1,049	0	1,049	1,204	0	1,204	(155)
2065	1,062	0	1,062	1,219	0	1,219	(157)
2066	1,074	0	1,074	1,234	0	1,234	(159)
2067	1,087	0	1,087	1,248	0	1,248	(161)
2068	1,099	0	1,099	1,263	0	1,263	(164)
2069	1,112	0	1,112	1,278	0	1,278	(166)
2070	1,125	0	1,125	1,293	0	1,293	(168)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Pflugerville's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	119	0	0	0
1	2015	57,122	118	25	366	341
2	2016	61,200	117	54	381	328
3	2017	65,278	115	86	395	309
4	2018	69,356	114	122	409	288
5-year Goal	2019	73,434	113	161	423	262
6	2020	77,512	112	204	437	233
7	2021	80,259	111	246	451	205
8	2022	83,006	109	291	465	174
9	2023	85,753	108	338	479	141
10-year Goal	2024	88,500	107	388	493	105

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Pflugerville's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	4.00	0	0	0
1	2015	57,122	4.40	(8)	0	8
2	2016	61,200	4.80	(18)	0	18
3	2017	65,278	5.20	(29)	0	29
4	2018	69,356	5.60	(41)	0	41
5-year Goal	2019	73,434	6.00	(54)	0	54
6	2020	77,512	5.80	(51)	0	51
7	2021	80,259	5.60	(47)	0	47
8	2022	83,006	5.40	(42)	0	42
9	2023	85,753	5.20	(38)	0	38
10-year Goal	2024	88,500	5.00	(32)	0	32

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 13.0% increase in 2014
    b. Estimated customer demand reduction of 2.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 7.37% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

[17] Correspondence with utility staff.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

6. **Rain Barrels**
    a. Approximately 300 50- and 54-gallon barrels distributed from 2013 – 2016
    b. In Region K, estimated savings of 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    c. Estimated 10-year useful life for most barrels

7. **Valve-type HE Toilet Rebate (ICI)**
    a. 433 toilets replaced from 2012 – 2013
    b. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
    c. 20-year useful life for fixture[19]

8. **Showerhead Distribution (SF)**
    a. Approximately 1,420 showerheads replaced since 2011
    b. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
    c. 5-year useful life
        i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

9. **HE Toilet Rebate (MF)**
    a. 817 toilets replaced in 2011
    b. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    c. 20-year useful life for fixture[20]

10. **Outdoor Landscape Evaluations (SF)**
    a. 169 outdoor evaluations performed from 2012 – 2016
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
        i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

11. **Low-flush Urinal Replacement Program (ICI)**
    a. 166 urinals replaced with 1/2 gallon-per-flush model
    b. Estimated 6,200 gallons per year per toilet (A&N Technical Services, 2005)
    c. 20-year useful life for fixture[21]

---

[19] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.
[20] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.
[21] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

12. Drop-by-Drop Program

a. Not quantified at this time.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Water Rate Increase	1/2 Gal. Flush Urinals (ICI)	Valve-type HE Toilets (ICI)	2x Watering Ordinance	Outdoor Residential Surveys (SF)	HE Toilets (MF)	Low Flow Showerheads (SF)	TOTAL SAVINGS
2010									0
2011							8.5	1.3	9.8
2012			0.7	2.1		0.21	8.5	1.3	12.8
2013	0.3		1.1	3.5	236	0.46	8.5	2.3	251.8
2014	0.6	87	1.1	5.6	246	0.46	8.5	2.5	351.6
2015	0.9	90	1.1	5.6	256	0.67	8.5	2.7	366.4
2016	1.3	94	1.1	5.6	267	0.90	8.5	2.9	381.3
2017	1.3	98	1.1	5.6	277	0.63	8.5	2.9	395.2
2018	1.3	102	1.1	5.6	288	0.40	8.5	2.9	409.1
2019	1.3	105	1.1	5.6	298	0.23	8.5	2.9	423.0
2020	1.3	109	1.1	5.6	309	0.08	8.5	2.9	437.0
2021	1.3	113	1.1	5.6	319		8.5	2.9	451.1
2022	1.3	116	1.1	5.6	330		8.5	2.9	465.2
2023	0.9	120	1.1	5.6	340		8.5	2.9	479.0
2024	0.6	124	1.1	5.6	350		8.5	2.9	492.8
2025	0.3	127	1.1	5.6	361		8.5	2.9	506.6
2026		131	1.1	5.6	371		8.5	2.9	520.5
2027		135	1.1	5.6	382		8.5	2.9	534.6
2028		138	1.1	5.6	392		8.5	2.9	548.7
2029		142	1.1	5.6	403		8.5	2.9	562.8
2030		146	1.1	5.6	413		8.5	2.9	577.0
2031		149	1.1	5.6	423		8.5	2.9	590.5
2032		153	1.1	5.6	433		8.5	2.9	604.0
2033		156	1.1	5.6	443		8.5	2.9	617.5
2034		160	1.1	5.6	453		8.5	2.9	631.1
2035		163	1.1	5.6	463		8.5	2.9	644.6
2036		167	1.1	5.6	473		8.5	2.9	658.1
2037		170	1.1	5.6	483		8.5	2.9	671.6
2038		174	1.1	5.6	493		8.5	2.9	685.1
2039		177	1.1	5.6	503		8.5	2.9	698.7
2040		181	1.1	5.6	513		8.5	2.9	712.2
2041		185	1.1	5.6	524		8.5	2.9	727.4
2042		189	1.1	5.6	536		8.5	2.9	742.6
2043		193	1.1	5.6	547		8.5	2.9	757.8
2044		197	1.1	5.6	558		8.5	2.9	773.0
2045		201	1.1	5.6	569		8.5	2.9	788.2
2046		205	1.1	5.6	580		8.5	2.9	803.4
2047		209	1.1	5.6	592		8.5	2.9	818.6
2048		213	1.1	5.6	603		8.5	2.9	833.8
2049		217	1.1	5.6	614		8.5	2.9	849.0
2050		221	1.1	5.6	625		8.5	2.9	864.2
2051		224	1.1	5.6	635		8.5	2.9	877.7
2052		228	1.1	5.6	645		8.5	2.9	891.1
2053		231	1.1	5.6	655		8.5	2.9	904.6
2054		235	1.1	5.6	665		8.5	2.9	918.1
2055		238	1.1	5.6	675		8.5	2.9	931.5
2056		242	1.1	5.6	685		8.5	2.9	945.0
2057		245	1.1	5.6	695		8.5	2.9	958.5
2058		249	1.1	5.6	705		8.5	2.9	972.0
2059		252	1.1	5.6	715		8.5	2.9	985.4
2060		256	1.1	5.6	725		8.5	2.9	998.9
2061		259	1.1	5.6	734		8.5	2.9	1,011.5
2062		262	1.1	5.6	744		8.5	2.9	1,024.0
2063		266	1.1	5.6	753		8.5	2.9	1,036.6
2064		269	1.1	5.6	762		8.5	2.9	1,049.2
2065		272	1.1	5.6	771		8.5	2.9	1,061.7
2066		275	1.1	5.6	781		8.5	2.9	1,074.3
2067		279	1.1	5.6	790		8.5	2.9	1,086.9
2068		282	1.1	5.6	799		8.5	2.9	1,099.5
2069		285	1.1	5.6	809		8.5	2.9	1,112.0
2070		289	1.1	5.6	818		8.5	2.9	1,124.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	4.00	0
2015	57,122	4.00	0
2016	61,200	4.00	0
2017	65,278	4.00	0
2018	69,356	4.00	0
2019	73,434	4.00	0
2020	77,512	4.00	0
2021	80,259	4.00	0
2022	83,006	4.00	0
2023	85,753	4.00	0
2024	88,500	4.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[22]

[22] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	381	0	381	49	109	0	109	320
2017	395	0	395	50	109	0	109	336
2018	409	0	409	52	131	0	131	330
2019	423	0	423	54	153	0	153	324
2020	437	0	437	56	197	0	197	296
2021	451	0	451	58	246	0	246	263
2022	465	0	465	60	295	0	295	230
2023	479	0	479	62	344	0	344	197
2024	493	0	493	64	393	0	393	164
2025	507	0	507	66	441	0	441	131
2026	520	0	520	68	490	0	490	98
2027	535	0	535	69	539	0	539	65
2028	549	0	549	71	588	0	588	32
2029	563	0	563	73	637	0	637	(1)
2030	577	0	577	75	686	0	686	(34)
2031	590	0	590	77	703	0	703	(36)
2032	604	0	604	79	720	0	720	(37)
2033	618	0	618	81	737	0	737	(39)
2034	631	0	631	82	754	0	754	(40)
2035	645	0	645	84	771	0	771	(42)
2036	658	0	658	86	788	0	788	(44)
2037	672	0	672	88	805	0	805	(45)
2038	685	0	685	90	822	0	822	(47)
2039	699	0	699	91	839	0	839	(48)
2040	712	0	712	93	855	0	855	(50)

Statewide Water Conservation Quantification Project
Travis County WCID #17 Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Travis County WCID #17's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) Travis County WCID #17's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Travis County WCID #17's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Travis County WCID #17 with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	90.7	96	187	124	0	124	63
2016	92.4	96	189	154	0	154	34
2017	92.0	96	189	154	0	154	34
2018	91.9	97	188	185	0	185	3
2019	92.8	97	189	216	0	216	(27)
2020	94.3	97	191	278	0	278	(87)
2021	96.0	99	195	310	0	310	(115)
2022	97.7	101	198	341	0	341	(143)
2023	99.4	103	202	373	0	373	(171)
2024	101.1	104	206	405	0	405	(199)
2025	102.8	106	209	436	0	436	(227)
2026	104.5	108	213	468	0	468	(255)
2027	106.2	110	216	500	0	500	(283)
2028	107.9	112	220	531	0	531	(311)
2029	109.6	114	224	563	0	563	(339)
2030	111.3	116	227	595	0	595	(367)
2031	112.3	117	230	613	0	613	(384)
2032	113.4	118	232	632	0	632	(400)
2033	114.4	120	234	651	0	651	(417)
2034	115.4	121	236	670	0	670	(433)
2035	116.4	122	238	688	0	688	(450)
2036	117.5	123	240	707	0	707	(467)
2037	118.5	124	243	726	0	726	(483)
2038	119.5	125	245	744	0	744	(500)
2039	120.5	126	247	763	0	763	(516)
2040	121.6	128	249	782	0	782	(533)
2041	121.7	128	250	798	0	798	(548)
2042	121.9	128	250	814	0	814	(564)
2043	122.1	128	250	830	0	830	(579)
2044	122.3	129	251	846	0	846	(595)
2045	122.5	129	251	862	0	862	(610)
2046	122.7	129	252	878	0	878	(626)
2047	122.8	129	252	894	0	894	(642)
2048	123.0	129	252	910	0	910	(657)
2049	123.2	130	253	926	0	926	(673)
2050	123.4	130	253	942	0	942	(688)
2051	123.7	130	254	956	0	956	(702)
2052	124.0	131	255	970	0	970	(715)
2053	124.3	131	255	984	0	984	(729)
2054	124.6	131	256	998	0	998	(742)
2055	124.9	132	257	1,013	0	1,013	(756)
2056	125.2	132	257	1,027	0	1,027	(770)
2057	125.6	132	258	1,041	0	1,041	(783)
2058	125.9	133	259	1,055	0	1,055	(797)
2059	126.2	133	259	1,069	0	1,069	(810)
2060	126.5	133	260	1,084	0	1,084	(824)
2061	126.9	134	261	1,127	0	1,127	(866)
2062	127.3	134	261	1,170	0	1,170	(908)
2063	127.6	135	262	1,213	0	1,213	(950)
2064	128.0	135	263	1,256	0	1,256	(993)
2065	128.4	135	264	1,299	0	1,299	(1,035)
2066	128.8	136	265	1,342	0	1,342	(1,077)
2067	129.2	136	266	1,385	0	1,385	(1,119)
2068	129.6	137	266	1,428	0	1,428	(1,161)
2069	130.0	137	267	1,471	0	1,471	(1,204)
2070	130.3	138	268	1,514	0	1,514	(1,246)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Travis County WCID #17's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	170	0	0	0
1	2013	31,800	168	23	92	69
2	2014	32,400	166	47	92	45
3	2015	33,000	164	72	187	115
4	2016	33,023	162	96	189	92
5-year Goal	2017	33,047	160	121	189	68
6	2018	33,070	160	123	188	65
7	2019	33,094	160	126	189	64
8	2020	33,117	159	128	191	63
9	2021	33,779	159	133	195	61
10-year Goal	2022	34,442	159	138	198	60

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Travis County WCID #17's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	21.00	0	0	0
1	2013	31,800	20.00	12	116	104
2	2014	32,400	19.00	24	59	35
3	2015	33,000	18.00	36	96	60
4	2016	33,023	17.00	48	96	48
5-year Goal	2017	33,047	16.00	60	96	36
6	2018	33,070	15.20	70	97	27
7	2019	33,094	14.40	80	97	17
8	2020	33,117	13.60	89	97	7
9	2021	33,779	12.80	101	99	(2)
10-year Goal	2022	34,442	12.00	113	101	(13)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 96 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 3.27% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
        i. Measure is mandatory only during peak season
        ii. Conservatively estimated at 50% of full savings of a permanent, year-round ordinance with an enforcement scheme, which is has estimated savings of 6.53% of total demand in Region K
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

5. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. 382 toilets replaced from 2010 – 2012
    b. Number of toilets per year provided by staff
    c. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    d. Savings carry on indefinitely because replacement toilet will be as efficient

6. **High Efficiency (HE) Toilet Replacement Program (MF)**
    a. 2 toilets replaced in 2012
    b. Number of toilets per year provided by staff
    c. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

d. Savings carry on indefinitely because replacement toilet will be as efficient

7. **Showerhead Distribution (SF)**
   a. 423 showerheads replaced from 2010 – 2012
   b. Number of showerheads per year provided by staff
   c. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
   d. 5-year useful life
      i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

8. **Large Landscape Irrigation System Audits**
   a. 49 audits performed from 2010 – 2015
   b. Number of audits per year provided by staff
   c. Estimated savings of 164,500 gallons per year per audit
   d. Used EPA WaterSense Water Budget Tool Formula[17] with 87,120 sq. ft. as basis for large landscape hydrozone
   e. Savings assumed to last 5 years with no decay rate

9. **Outdoor Landscape Audits (SF)**
   a. 501 outdoor audits performed from 2010 – 2015
   b. Number of audits per year provided by staff
   c. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
      i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
   d. Approximately 22 gallons per day
   e. Greater savings during peak periods
   f. Lesser savings during off-peak periods
   g. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

[17] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance (Peak Season)	HE Toilets (SF)	HE Toilets (MF)	Tank Type HE Toilets (ICI)	Low Flow Showerheads (SF)	Residential Surveys (SF)	Large Landscape Surveys (ICI)	TOTAL SAVINGS
2009								0
2010		3.5			0.2	0.8	2.5	7
2011		3.5		0.03	0.3	1.4	5.8	11
2012	76	4.0	0.03	0.03	0.3	1.8	5.6	88
2013	78	4.0	0.03	0.03	0.3	2.0	8.1	92
2014	80	4.0	0.03	0.03	0.3	1.5	6.4	92
2015	81	4.0	0.03	0.03	0.3	1.0	3.9	91
2016	83	4.0	0.03	0.03	0.3	1.0	3.9	92
2017	85	4.0	0.03	0.03	0.3	0.6	2.3	92
2018	87	4.0	0.03	0.03	0.3	0.2	0.8	92
2019	88	4.0	0.03	0.03	0.3	0.2		93
2020	90	4.0	0.03	0.03	0.3			94
2021	92	4.0	0.03	0.03	0.3			96
2022	93	4.0	0.03	0.03	0.3			98
2023	95	4.0	0.03	0.03	0.3			99
2024	97	4.0	0.03	0.03	0.3			101
2025	98	4.0	0.03	0.03	0.3			103
2026	100	4.0	0.03	0.03	0.3			104
2027	102	4.0	0.03	0.03	0.3			106
2028	104	4.0	0.03	0.03	0.3			108
2029	105	4.0	0.03	0.03	0.3			110
2030	107	4.0	0.03	0.03	0.3			111
2031	108	4.0	0.03	0.03	0.3			112
2032	109	4.0	0.03	0.03	0.3			113
2033	110	4.0	0.03	0.03	0.3			114
2034	111	4.0	0.03	0.03	0.3			115
2035	112	4.0	0.03	0.03	0.3			116
2036	113	4.0	0.03	0.03	0.3			117
2037	114	4.0	0.03	0.03	0.3			118
2038	115	4.0	0.03	0.03	0.3			120
2039	116	4.0	0.03	0.03	0.3			121
2040	117	4.0	0.03	0.03	0.3			122
2041	117	4.0	0.03	0.03	0.3			122
2042	118	4.0	0.03	0.03	0.3			122
2043	118	4.0	0.03	0.03	0.3			122
2044	118	4.0	0.03	0.03	0.3			122
2045	118	4.0	0.03	0.03	0.3			122
2046	118	4.0	0.03	0.03	0.3			123
2047	118	4.0	0.03	0.03	0.3			123
2048	119	4.0	0.03	0.03	0.3			123
2049	119	4.0	0.03	0.03	0.3			123
2050	119	4.0	0.03	0.03	0.3			123
2051	119	4.0	0.03	0.03	0.3			124
2052	120	4.0	0.03	0.03	0.3			124
2053	120	4.0	0.03	0.03	0.3			124
2054	120	4.0	0.03	0.03	0.3			125
2055	121	4.0	0.03	0.03	0.3			125
2056	121	4.0	0.03	0.03	0.3			125
2057	121	4.0	0.03	0.03	0.3			126
2058	122	4.0	0.03	0.03	0.3			126
2059	122	4.0	0.03	0.03	0.3			126
2060	122	4.0	0.03	0.03	0.3			126
2061	123	4.0	0.03	0.03	0.3			127
2062	123	4.0	0.03	0.03	0.3			127
2063	123	4.0	0.03	0.03	0.3			128
2064	124	4.0	0.03	0.03	0.3			128
2065	124	4.0	0.03	0.03	0.3			128
2066	124	4.0	0.03	0.03	0.3			129
2067	125	4.0	0.03	0.03	0.3			129
2068	125	4.0	0.03	0.03	0.3			130
2069	126	4.0	0.03	0.03	0.3			130
2070	126	4.0	0.03	0.03	0.3			130

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	21.00	0
2013	31,800	11.00	116
2014	32,400	16.00	59
2015	33,000	13.00	96
2016	33,023	13.00	96
2017	33,047	13.00	96
2018	33,070	13.00	97
2019	33,094	13.00	97
2020	33,117	13.00	97
2021	33,779	13.00	99
2022	34,442	13.00	101

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

   i. This was the most common percentage of residential use among participating utilities in this project.

   ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	92	96	189	34	154	0	154	68
2017	92	96	189	35	154	0	154	69
2018	92	97	188	36	185	0	185	39
2019	93	97	189	36	216	0	216	9
2020	94	97	191	37	278	0	278	(50)
2021	96	99	195	38	310	0	310	(77)
2022	98	101	198	38	341	0	341	(105)
2023	99	103	202	39	373	0	373	(132)
2024	101	104	206	40	405	0	405	(159)
2025	103	106	209	40	436	0	436	(187)
2026	104	108	213	41	468	0	468	(214)
2027	106	110	216	42	500	0	500	(241)
2028	108	112	220	43	531	0	531	(269)
2029	110	114	224	43	563	0	563	(296)
2030	111	116	227	44	595	0	595	(324)
2031	112	117	230	44	613	0	613	(340)
2032	113	118	232	45	632	0	632	(356)
2033	114	120	234	45	651	0	651	(372)
2034	115	121	236	46	670	0	670	(388)
2035	116	122	238	46	688	0	688	(404)
2036	117	123	240	46	707	0	707	(420)
2037	118	124	243	47	726	0	726	(436)
2038	120	125	245	47	744	0	744	(452)
2039	121	126	247	48	763	0	763	(468)
2040	122	128	249	48	782	0	782	(485)

2. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 51 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	92	96	189	51	154	0	154	85
2017	92	96	189	52	154	0	154	86
2018	92	97	188	53	185	0	185	56
2019	93	97	189	54	216	0	216	27
2020	94	97	191	55	278	0	278	(32)
2021	96	99	195	56	310	0	310	(59)
2022	98	101	198	57	341	0	341	(86)
2023	99	103	202	58	373	0	373	(113)
2024	101	104	206	59	405	0	405	(140)
2025	103	106	209	60	436	0	436	(167)
2026	104	108	213	61	468	0	468	(194)
2027	106	110	216	62	500	0	500	(221)
2028	108	112	220	63	531	0	531	(248)
2029	110	114	224	64	563	0	563	(275)
2030	111	116	227	66	595	0	595	(302)
2031	112	117	230	66	613	0	613	(318)
2032	113	118	232	67	632	0	632	(334)
2033	114	120	234	67	651	0	651	(350)
2034	115	121	236	68	670	0	670	(365)
2035	116	122	238	69	688	0	688	(381)
2036	117	123	240	69	707	0	707	(397)
2037	118	124	243	70	726	0	726	(413)
2038	120	125	245	71	744	0	744	(429)
2039	121	126	247	71	763	0	763	(445)
2040	122	128	249	72	782	0	782	(461)

3. Rain Barrels
   a. In Region K, utilities could save approximately 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
West Travis County Public Utility Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares West Travis County Public Utility 's current water conservation activities and their quantified savings to two metrics: 1) Region K Water Plan's (Texas Water Development Board, 2016i) recommended WMS supply volumes for municipal conservation, and 2) West Travis County Public Utility 's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in West Travis County Public Utility 's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for West Travis County Public Utility with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	116.9	(98)	19	93	0	93	(74)
2016	93.7	(100)	(7)	116	0	116	(122)
2017	70.5	(103)	(32)	116	0	116	(148)
2018	47.3	(105)	(58)	139	0	139	(197)
2019	24.1	(107)	(83)	162	0	162	(245)
2020	0.9	(110)	(109)	208	0	208	(317)
2021	0.9	(113)	(112)	239	0	239	(351)
2022	0.9	(117)	(116)	269	0	269	(385)
2023	0.9	(120)	(119)	300	0	300	(419)
2024	0.9	(124)	(123)	330	0	330	(453)
2025	0.9	(127)	(126)	361	0	361	(487)
2026	0.9	(131)	(130)	391	0	391	(521)
2027	0.9	(134)	(133)	422	0	422	(555)
2028	0.9	(138)	(137)	452	0	452	(589)
2029	0.9	(141)	(140)	483	0	483	(623)
2030	0.9	(145)	(144)	513	0	513	(657)
2031	0.9	(149)	(148)	556	0	556	(703)
2032	0.9	(153)	(152)	598	0	598	(750)
2033	0.9	(157)	(156)	640	0	640	(796)
2034	0.9	(161)	(160)	682	0	682	(843)
2035	0.9	(165)	(164)	725	0	725	(889)
2036	0.9	(169)	(168)	767	0	767	(935)
2037	0.9	(173)	(172)	809	0	809	(982)
2038	0.9	(177)	(176)	852	0	852	(1,028)
2039	0.9	(181)	(180)	894	0	894	(1,074)
2040	0.9	(185)	(185)	936	0	936	(1,121)
2041	0.9	(190)	(190)	995	0	995	(1,184)
2042	0.9	(195)	(195)	1,053	0	1,053	(1,248)
2043	0.9	(200)	(200)	1,112	0	1,112	(1,311)
2044	0.9	(205)	(205)	1,170	0	1,170	(1,375)
2045	0.9	(211)	(210)	1,228	0	1,228	(1,438)
2046	0.9	(216)	(215)	1,287	0	1,287	(1,501)
2047	0.9	(221)	(220)	1,345	0	1,345	(1,565)
2048	0.9	(226)	(225)	1,404	0	1,404	(1,628)
2049	0.9	(231)	(230)	1,462	0	1,462	(1,692)
2050	0.9	(236)	(235)	1,520	0	1,520	(1,755)
2051	0.9	(241)	(240)	1,592	0	1,592	(1,833)
2052	0.9	(247)	(246)	1,664	0	1,664	(1,910)
2053	0.9	(252)	(251)	1,736	0	1,736	(1,988)
2054	0.9	(258)	(257)	1,808	0	1,808	(2,065)
2055	0.9	(263)	(262)	1,880	0	1,880	(2,143)
2056	0.9	(269)	(268)	1,952	0	1,952	(2,220)
2057	0.9	(274)	(273)	2,024	0	2,024	(2,298)
2058	0.9	(280)	(279)	2,096	0	2,096	(2,375)
2059	0.9	(285)	(284)	2,168	0	2,168	(2,453)
2060	0.9	(291)	(290)	2,240	0	2,240	(2,530)
2061	0.9	(297)	(296)	2,328	0	2,328	(2,624)
2062	0.9	(303)	(302)	2,416	0	2,416	(2,719)
2063	0.9	(309)	(309)	2,504	0	2,504	(2,813)
2064	0.9	(316)	(315)	2,592	0	2,592	(2,907)
2065	0.9	(322)	(321)	2,680	0	2,680	(3,001)
2066	0.9	(328)	(327)	2,768	0	2,768	(3,095)
2067	0.9	(334)	(333)	2,856	0	2,856	(3,189)
2068	0.9	(340)	(339)	2,944	0	2,944	(3,283)
2069	0.9	(346)	(345)	3,032	0	3,032	(3,378)
2070	0.9	(352)	(352)	3,120	0	3,120	(3,472)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how West Travis County Public Utility 's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	139	0	0	0
1	2015	13,414	167	(138)	19	157
2	2016	13,734	195	(283)	(7)	276
3	2017	14,054	224	(434)	(32)	402
4	2018	14,375	252	(592)	(58)	534
5-year Goal	2019	14,695	280	(756)	(83)	673
6	2020	15,015	267	(702)	(109)	593
7	2021	15,494	254	(650)	(112)	538
8	2022	15,972	241	(595)	(116)	479
9	2023	16,451	228	(534)	(119)	415
10-year Goal	2024	16,929	215	(470)	(123)	347

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how West Travis County Public Utility ’s most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility’s baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility’s five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility’s established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	40.00	0	0	0
1	2015	13,414	40.40	(2)	(98)	(96)
2	2016	13,734	40.80	(4)	(100)	(96)
3	2017	14,054	41.20	(6)	(103)	(96)
4	2018	14,375	41.60	(8)	(105)	(97)
5-year Goal	2019	14,695	42.00	(11)	(107)	(97)
6	2020	15,015	38.00	11	(110)	(121)
7	2021	15,494	34.00	34	(113)	(147)
8	2022	15,972	30.00	58	(117)	(175)
9	2023	16,451	26.00	84	(120)	(204)
10-year Goal	2024	16,929	22.00	111	(124)	(235)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 98 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
        i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5. **Twice-a-week Outdoor Watering Restriction Ordinance**
    a. Estimated savings of 6.53% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
    b. All savings estimates grow each year at the same rate demand figures for the utility grow in the regional water plan.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

c. The 2x permanent watering ordinance was repealed and discontinued after 2015.
    i. Assumed that savings for this activity will phase out over five years, nearing zero in 2020.

6. High Efficiency (HE) Toilet Rebate

a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
b. Savings carry on indefinitely because replacement toilet will be as efficient

7. HE Toilet Rebate for Industrial-Commercial-Institutional (ICI) Customers

a. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
b. 20-year useful life for fixture[17]

8. Showerhead Distribution for Single Family (SF) Customers

a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
b. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

[17] Plumbing code and efficiency standards effectively make the savings permanent, as new high-efficiency models will replace these toilets.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Tank-type HE Toilets (ICI)	Low Flow Showerheads (SF)	HE Toilets (SF)	TOTAL SAVINGS
2009	90				90.2
2010	95				94.5
2011	99	0.25			99.1
2012	103	0.25	0.26	0.35	104.0
2013	107	0.25	0.26	0.35	108.3
2014	112	0.25	0.26	0.35	112.6
2015	116	0.25	0.26	0.35	116.9
2016	93	0.25	0.26	0.35	93.7
2017	70	0.25	0.26	0.35	70.5
2018	46	0.25	0.26	0.35	47.3
2019	23	0.25	0.26	0.35	24.1
2020		0.25	0.26	0.35	0.9
2021		0.25	0.26	0.35	0.9
2022		0.25	0.26	0.35	0.9
2023		0.25	0.26	0.35	0.9
2024		0.25	0.26	0.35	0.9
2025		0.25	0.26	0.35	0.9
2026		0.25	0.26	0.35	0.9
2027		0.25	0.26	0.35	0.9
2028		0.25	0.26	0.35	0.9
2029		0.25	0.26	0.35	0.9
2030		0.25	0.26	0.35	0.9
2031		0.25	0.26	0.35	0.9
2032		0.25	0.26	0.35	0.9
2033		0.25	0.26	0.35	0.9
2034		0.25	0.26	0.35	0.9
2035		0.25	0.26	0.35	0.9
2036		0.25	0.26	0.35	0.9
2037		0.25	0.26	0.35	0.9
2038		0.25	0.26	0.35	0.9
2039		0.25	0.26	0.35	0.9
2040		0.25	0.26	0.35	0.9
2041		0.25	0.26	0.35	0.9
2042		0.25	0.26	0.35	0.9
2043		0.25	0.26	0.35	0.9
2044		0.25	0.26	0.35	0.9
2045		0.25	0.26	0.35	0.9
2046		0.25	0.26	0.35	0.9
2047		0.25	0.26	0.35	0.9
2048		0.25	0.26	0.35	0.9
2049		0.25	0.26	0.35	0.9
2050		0.25	0.26	0.35	0.9
2051		0.25	0.26	0.35	0.9
2052		0.25	0.26	0.35	0.9
2053		0.25	0.26	0.35	0.9
2054		0.25	0.26	0.35	0.9
2055		0.25	0.26	0.35	0.9
2056		0.25	0.26	0.35	0.9
2057		0.25	0.26	0.35	0.9
2058		0.25	0.26	0.35	0.9
2059		0.25	0.26	0.35	0.9
2060		0.25	0.26	0.35	0.9
2061		0.25	0.26	0.35	0.9
2062		0.25	0.26	0.35	0.9
2063		0.25	0.26	0.35	0.9
2064		0.25	0.26	0.35	0.9
2065		0.25	0.26	0.35	0.9
2066		0.25	0.26	0.35	0.9
2067		0.25	0.26	0.35	0.9
2068		0.25	0.26	0.35	0.9
2069		0.25	0.26	0.35	0.9
2070		0.25	0.26	0.35	0.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	40.00	0
2015	13,414	60.00	(98)
2016	13,734	60.00	(100)
2017	14,054	60.00	(103)
2018	14,375	60.00	(105)
2019	14,695	60.00	(107)
2020	15,015	60.00	(110)
2021	15,494	60.00	(113)
2022	15,972	60.00	(117)
2023	16,451	60.00	(120)
2024	16,929	60.00	(124)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[18]

g. See Table 6-1 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	94	(100)	(7)	25	116	0	116	(98)
2017	70	(103)	(32)	26	116	0	116	(122)
2018	47	(105)	(58)	26	139	0	139	(170)
2019	24	(107)	(83)	27	162	0	162	(218)
2020	1	(110)	(109)	28	208	0	208	(289)
2021	1	(113)	(112)	29	239	0	239	(322)
2022	1	(117)	(116)	30	269	0	269	(355)
2023	1	(120)	(119)	31	300	0	300	(388)
2024	1	(124)	(123)	32	330	0	330	(421)
2025	1	(127)	(126)	33	361	0	361	(454)
2026	1	(131)	(130)	33	391	0	391	(487)
2027	1	(134)	(133)	34	422	0	422	(521)
2028	1	(138)	(137)	35	452	0	452	(554)
2029	1	(141)	(140)	36	483	0	483	(587)
2030	1	(145)	(144)	37	513	0	513	(620)
2031	1	(149)	(148)	38	556	0	556	(665)
2032	1	(153)	(152)	39	598	0	598	(711)
2033	1	(157)	(156)	40	640	0	640	(756)
2034	1	(161)	(160)	41	682	0	682	(801)
2035	1	(165)	(164)	42	725	0	725	(847)
2036	1	(169)	(168)	43	767	0	767	(892)
2037	1	(173)	(172)	44	809	0	809	(937)
2038	1	(177)	(176)	45	852	0	852	(983)
2039	1	(181)	(180)	46	894	0	894	(1,028)
2040	1	(185)	(185)	47	936	0	936	(1,073)

2. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 37 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	94	(100)	(7)	37	116	0	116	(85)
2017	70	(103)	(32)	38	116	0	116	(110)
2018	47	(105)	(58)	39	139	0	139	(157)
2019	24	(107)	(83)	41	162	0	162	(204)
2020	1	(110)	(109)	42	208	0	208	(275)
2021	1	(113)	(112)	43	239	0	239	(308)
2022	1	(117)	(116)	45	269	0	269	(340)
2023	1	(120)	(119)	46	300	0	300	(373)
2024	1	(124)	(123)	47	330	0	330	(406)
2025	1	(127)	(126)	49	361	0	361	(438)
2026	1	(131)	(130)	50	391	0	391	(471)
2027	1	(134)	(133)	51	422	0	422	(504)
2028	1	(138)	(137)	53	452	0	452	(536)
2029	1	(141)	(140)	54	483	0	483	(569)
2030	1	(145)	(144)	55	513	0	513	(602)
2031	1	(149)	(148)	57	556	0	556	(647)
2032	1	(153)	(152)	58	598	0	598	(691)
2033	1	(157)	(156)	60	640	0	640	(736)
2034	1	(161)	(160)	61	682	0	682	(781)
2035	1	(165)	(164)	63	725	0	725	(826)
2036	1	(169)	(168)	65	767	0	767	(871)
2037	1	(173)	(172)	66	809	0	809	(916)
2038	1	(177)	(176)	68	852	0	852	(960)
2039	1	(181)	(180)	69	894	0	894	(1,005)
2040	1	(185)	(185)	71	936	0	936	(1,050)

3. Rain Barrels
   a. In Region K, utilities could save approximately 22.4 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Region L Individual Reports

Statewide Water Conservation Quantification Project
City of Alamo Heights Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Alamo Heights' current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Alamo Heights' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Alamo Heights' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Alamo Heights with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	0	0	15	0	15	(15)
2016	0	0	0	19	0	19	(19)
2017	0	0	0	19	0	19	(19)
2018	0	0	0	23	0	23	(23)
2019	0	0	0	26	0	26	(26)
2020	0	0	0	34	0	34	(34)
2021	0	0	0	40	0	40	(40)
2022	0	0	0	45	0	45	(45)
2023	0	0	0	51	0	51	(51)
2024	0	0	0	57	0	57	(57)
2025	0	0	0	63	0	63	(63)
2026	0	0	0	68	0	68	(68)
2027	0	0	0	74	0	74	(74)
2028	0	0	0	80	0	80	(80)
2029	0	0	0	86	0	86	(86)
2030	0	0	0	91	0	91	(91)
2031	0	0	0	97	0	97	(97)
2032	0	0	0	102	0	102	(102)
2033	0	0	0	107	0	107	(107)
2034	0	0	0	112	0	112	(112)
2035	0	0	0	118	0	118	(118)
2036	0	0	0	123	0	123	(123)
2037	0	0	0	128	0	128	(128)
2038	0	0	0	133	0	133	(133)
2039	0	0	0	139	0	139	(139)
2040	0	0	0	144	0	144	(144)
2041	0	0	0	149	0	149	(149)
2042	0	0	0	154	0	154	(154)
2043	0	0	0	160	0	160	(160)
2044	0	0	0	165	0	165	(165)
2045	0	0	0	170	0	170	(170)
2046	0	0	0	175	0	175	(175)
2047	0	0	0	180	0	180	(180)
2048	0	0	0	186	0	186	(186)
2049	0	0	0	191	0	191	(191)
2050	0	0	0	196	0	196	(196)
2051	0	0	0	201	0	201	(201)
2052	0	0	0	206	0	206	(206)
2053	0	0	0	211	0	211	(211)
2054	0	0	0	216	0	216	(216)
2055	0	0	0	221	0	221	(221)
2056	0	0	0	226	0	226	(226)
2057	0	0	0	231	0	231	(231)
2058	0	0	0	236	0	236	(236)
2059	0	0	0	241	0	241	(241)
2060	0	0	0	246	0	246	(246)
2061	0	0	0	251	0	251	(251)
2062	0	0	0	255	0	255	(255)
2063	0	0	0	260	0	260	(260)
2064	0	0	0	264	0	264	(264)
2065	0	0	0	269	0	269	(269)
2066	0	0	0	273	0	273	(273)
2067	0	0	0	278	0	278	(278)
2068	0	0	0	283	0	283	(283)
2069	0	0	0	287	0	287	(287)
2070	0	0	0	292	0	292	(292)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Alamo Heights' quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	252	0	0	0
1	2009	7,046	247	13	0	(13)
2	2010	7,065	242	26	0	(26)
3	2011	7,084	237	39	0	(39)
4	2012	7,103	232	52	0	(52)
5-year Goal	2013	7,122	227	65	0	(65)
6	2014	7,141	225	71	0	(71)
7	2015	7,160	223	77	0	(77)
8	2016	7,347	220	85	0	(85)
9	2017	7,534	218	93	0	(93)
10-year Goal	2018	7,721	216	101	0	(101)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Alamo Heights' most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	25.00	0	0	0
1	2009	7,046	25	1	0	(1)
2	2010	7,065	24	3	0	(3)
3	2011	7,084	24	4	0	(4)
4	2012	7,103	23	5	0	(5)
5-year Goal	2013	7,122	23	6	0	(6)
6	2014	7,141	22	7	0	(7)
7	2015	7,160	22	8	0	(8)
8	2016	7,347	22	9	0	(9)
9	2017	7,534	22	10	0	(10)
10-year Goal	2018	7,721	21	11	0	(11)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	25.00	0
2015	7,160	25.00	0
2016	7,347	25.00	0
2017	7,534	25.00	0
2018	7,721	25.00	0
2019	7,908	25.00	0
2020	8,095	25.00	0
2021	8,128	25.00	0
2022	8,161	25.00	0
2023	8,193	25.00	0
2024	8,226	25.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs

    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  - **a.** Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - i. Average Region L savings
    - ii. Specific percentage of outdoor usage unknown for your utility at this time
  - **b.** Savings could be 44 MG per year with current demand.
  - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	44	19	0	19	25
2017	0	0	0	44	19	0	19	25
2018	0	0	0	44	23	0	23	21
2019	0	0	0	44	26	0	26	18
2020	0	0	0	44	34	0	34	10
2021	0	0	0	44	40	0	40	5
2022	0	0	0	44	45	0	45	(1)
2023	0	0	0	44	51	0	51	(7)
2024	0	0	0	45	57	0	57	(12)
2025	0	0	0	45	63	0	63	(18)
2026	0	0	0	45	68	0	68	(24)
2027	0	0	0	45	74	0	74	(29)
2028	0	0	0	45	80	0	80	(35)
2029	0	0	0	45	86	0	86	(40)
2030	0	0	0	45	91	0	91	(46)
2031	0	0	0	45	97	0	97	(51)
2032	0	0	0	45	102	0	102	(57)
2033	0	0	0	45	107	0	107	(62)
2034	0	0	0	45	112	0	112	(67)
2035	0	0	0	45	118	0	118	(73)
2036	0	0	0	45	123	0	123	(78)
2037	0	0	0	45	128	0	128	(83)
2038	0	0	0	45	133	0	133	(89)
2039	0	0	0	45	139	0	139	(94)
2040	0	0	0	45	144	0	144	(99)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

i. This was the most common percentage of residential use among participating utilities in this project.
ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	10	19	0	19	(9)
2017	0	0	0	10	19	0	19	(9)
2018	0	0	0	10	23	0	23	(13)
2019	0	0	0	10	26	0	26	(17)
2020	0	0	0	10	34	0	34	(24)
2021	0	0	0	10	40	0	40	(30)
2022	0	0	0	10	45	0	45	(36)
2023	0	0	0	10	51	0	51	(41)
2024	0	0	0	10	57	0	57	(47)
2025	0	0	0	10	63	0	63	(53)
2026	0	0	0	10	68	0	68	(58)
2027	0	0	0	10	74	0	74	(64)
2028	0	0	0	10	80	0	80	(70)
2029	0	0	0	10	86	0	86	(76)
2030	0	0	0	10	91	0	91	(81)
2031	0	0	0	10	97	0	97	(87)
2032	0	0	0	10	102	0	102	(92)
2033	0	0	0	10	107	0	107	(97)
2034	0	0	0	10	112	0	112	(103)
2035	0	0	0	10	118	0	118	(108)
2036	0	0	0	10	123	0	123	(113)
2037	0	0	0	10	128	0	128	(118)
2038	0	0	0	10	133	0	133	(124)
2039	0	0	0	10	139	0	139	(129)
2040	0	0	0	10	144	0	144	(134)

3. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 14 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

---

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	0	0	14	19	0	19	(5)
2017	0	0	0	14	19	0	19	(4)
2018	0	0	0	14	23	0	23	(8)
2019	0	0	0	14	26	0	26	(12)
2020	0	0	0	14	34	0	34	(19)
2021	0	0	0	14	40	0	40	(25)
2022	0	0	0	15	45	0	45	(31)
2023	0	0	0	15	51	0	51	(37)
2024	0	0	0	15	57	0	57	(42)
2025	0	0	0	15	63	0	63	(48)
2026	0	0	0	15	68	0	68	(54)
2027	0	0	0	15	74	0	74	(59)
2028	0	0	0	15	80	0	80	(65)
2029	0	0	0	15	86	0	86	(71)
2030	0	0	0	15	91	0	91	(76)
2031	0	0	0	15	97	0	97	(82)
2032	0	0	0	15	102	0	102	(87)
2033	0	0	0	15	107	0	107	(92)
2034	0	0	0	15	112	0	112	(98)
2035	0	0	0	15	118	0	118	(103)
2036	0	0	0	15	123	0	123	(108)
2037	0	0	0	15	128	0	128	(114)
2038	0	0	0	15	133	0	133	(119)
2039	0	0	0	15	139	0	139	(124)
2040	0	0	0	15	144	0	144	(129)

4. Rain Barrels
    a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Atascosa Rural WCS Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Atascosa Rural WCS's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Atascosa Rural WCS's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Atascosa Rural WCS's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Atascosa Rural WCS with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	2	2	0	0	0	2
2016	0	2	2	0	0	0	2
2017	0	2	2	0	0	0	2
2018	0	2	2	0	0	0	2
2019	0	2	2	0	0	0	2
2020	0	2	2	0	0	0	2
2021	0	2	2	0	0	0	2
2022	0	2	2	0	0	0	2
2023	0	2	2	0	0	0	2
2024	0	2	2	0	0	0	2
2025	0	3	3	0	0	0	3
2026	0	3	3	0	0	0	3
2027	0	3	3	0	0	0	3
2028	0	3	3	0	0	0	3
2029	0	3	3	0	0	0	3
2030	0	3	3	0	0	0	3
2031	0	3	3	0	0	0	3
2032	0	3	3	0	0	0	3
2033	0	3	3	0	0	0	3
2034	0	3	3	0	0	0	3
2035	0	3	3	0	0	0	3
2036	0	3	3	0	0	0	3
2037	0	3	3	0	0	0	3
2038	0	3	3	0	0	0	3
2039	0	3	3	0	0	0	3
2040	0	3	3	0	0	0	3
2041	0	3	3	0	0	0	3
2042	0	3	3	0	0	0	3
2043	0	3	3	0	0	0	3
2044	0	3	3	0	0	0	3
2045	0	3	3	0	0	0	3
2046	0	3	3	0	0	0	3
2047	0	4	4	0	0	0	4
2048	0	4	4	0	0	0	4
2049	0	4	4	0	0	0	4
2050	0	4	4	0	0	0	4
2051	0	4	4	0	0	0	4
2052	0	4	4	0	0	0	4
2053	0	4	4	0	0	0	4
2054	0	4	4	0	0	0	4
2055	0	4	4	0	0	0	4
2056	0	4	4	0	0	0	4
2057	0	4	4	0	0	0	4
2058	0	4	4	0	0	0	4
2059	0	4	4	0	0	0	4
2060	0	4	4	0	0	0	4
2061	0	4	4	2	0	2	2
2062	0	4	4	4	0	4	1
2063	0	4	4	5	0	5	(1)
2064	0	4	4	7	0	7	(3)
2065	0	4	4	9	0	9	(5)
2066	0	4	4	11	0	11	(7)
2067	0	4	4	13	0	13	(8)
2068	0	4	4	14	0	14	(10)
2069	0	4	4	16	0	16	(12)
2070	0	4	4	18	0	18	(14)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Atascosa Rural WCS's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	105	0	0	0
1	2015	13,492	104	5	2	(2)
2	2016	13,311	103	10	2	(7)
3	2017	13,129	102	14	2	(12)
4	2018	12,948	101	19	2	(17)
5-year Goal	2019	12,766	100	23	2	(21)
6	2020	12,585	99	28	2	(25)
7	2021	12,846	98	33	2	(30)
8	2022	13,107	97	38	2	(36)
9	2023	13,368	96	44	2	(41)
10-year Goal	2024	13,629	95	50	2	(47)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Atascosa Rural WCS's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.50	0	0	0
1	2015	13,492	12	4	2	(2)
2	2016	13,311	11	8	2	(6)
3	2017	13,129	10	12	2	(10)
4	2018	12,948	9	16	2	(14)
5-year Goal	2019	12,766	8	20	2	(17)
6	2020	12,585	8	22	2	(20)
7	2021	12,846	7	25	2	(23)
8	2022	13,107	7	29	2	(26)
9	2023	13,368	6	32	2	(30)
10-year Goal	2024	13,629	5	36	2	(33)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.

[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	12.50	0
2015	13,492	12.00	2
2016	13,311	12.00	2
2017	13,129	12.00	2
2018	12,948	12.00	2
2019	12,766	12.00	2
2020	12,585	12.00	2
2021	12,846	12.00	2
2022	13,107	12.00	2
2023	13,368	12.00	2
2024	13,629	12.00	2

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region L savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 30 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	2	2	30	0	0	0	32
2017	0	2	2	30	0	0	0	33
2018	0	2	2	31	0	0	0	33
2019	0	2	2	31	0	0	0	34
2020	0	2	2	32	0	0	0	34
2021	0	2	2	32	0	0	0	35
2022	0	2	2	33	0	0	0	35
2023	0	2	2	33	0	0	0	36
2024	0	2	2	34	0	0	0	36
2025	0	3	3	35	0	0	0	37
2026	0	3	3	35	0	0	0	38
2027	0	3	3	36	0	0	0	38
2028	0	3	3	36	0	0	0	39
2029	0	3	3	37	0	0	0	40
2030	0	3	3	37	0	0	0	40
2031	0	3	3	38	0	0	0	41
2032	0	3	3	38	0	0	0	41
2033	0	3	3	39	0	0	0	42
2034	0	3	3	39	0	0	0	42
2035	0	3	3	40	0	0	0	43
2036	0	3	3	40	0	0	0	44
2037	0	3	3	41	0	0	0	44
2038	0	3	3	42	0	0	0	45
2039	0	3	3	42	0	0	0	45
2040	0	3	3	43	0	0	0	46

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	2	2	6	0	0	0	9
2017	0	2	2	7	0	0	0	9
2018	0	2	2	7	0	0	0	9
2019	0	2	2	7	0	0	0	9
2020	0	2	2	7	0	0	0	9
2021	0	2	2	7	0	0	0	9
2022	0	2	2	7	0	0	0	10
2023	0	2	2	7	0	0	0	10
2024	0	2	2	7	0	0	0	10
2025	0	3	3	8	0	0	0	10
2026	0	3	3	8	0	0	0	10
2027	0	3	3	8	0	0	0	10
2028	0	3	3	8	0	0	0	11
2029	0	3	3	8	0	0	0	11
2030	0	3	3	8	0	0	0	11
2031	0	3	3	8	0	0	0	11
2032	0	3	3	8	0	0	0	11
2033	0	3	3	9	0	0	0	11
2034	0	3	3	9	0	0	0	12
2035	0	3	3	9	0	0	0	12
2036	0	3	3	9	0	0	0	12
2037	0	3	3	9	0	0	0	12
2038	0	3	3	9	0	0	0	12
2039	0	3	3	9	0	0	0	12
2040	0	3	3	9	0	0	0	13

3. Water Rate Increase
- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 10 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	2	2	10	0	0	0	12
2017	0	2	2	10	0	0	0	12
2018	0	2	2	10	0	0	0	12
2019	0	2	2	10	0	0	0	13
2020	0	2	2	10	0	0	0	13
2021	0	2	2	11	0	0	0	13
2022	0	2	2	11	0	0	0	13
2023	0	2	2	11	0	0	0	13
2024	0	2	2	11	0	0	0	14
2025	0	3	3	11	0	0	0	14
2026	0	3	3	11	0	0	0	14
2027	0	3	3	12	0	0	0	14
2028	0	3	3	12	0	0	0	15
2029	0	3	3	12	0	0	0	15
2030	0	3	3	12	0	0	0	15
2031	0	3	3	12	0	0	0	15
2032	0	3	3	13	0	0	0	15
2033	0	3	3	13	0	0	0	16
2034	0	3	3	13	0	0	0	16
2035	0	3	3	13	0	0	0	16
2036	0	3	3	13	0	0	0	16
2037	0	3	3	13	0	0	0	16
2038	0	3	3	14	0	0	0	17
2039	0	3	3	14	0	0	0	17
2040	0	3	3	14	0	0	0	17

4. Rain Barrels
   a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Crystal Clear SUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Crystal Clear SUD's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Crystal Clear SUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Crystal Clear SUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Crystal Clear SUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. **Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.**

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	12	(41)	(29)	0	0	0	(29)
2016	34	(42)	(8)	0	0	0	(8)
2017	34	(42)	(8)	0	0	0	(8)
2018	35	(42)	(7)	0	0	0	(7)
2019	35	(42)	(7)	0	0	0	(7)
2020	36	(42)	(7)	0	0	0	(7)
2021	36	(43)	(6)	0	0	0	(6)
2022	37	(43)	(6)	0	0	0	(6)
2023	37	(43)	(6)	0	0	0	(6)
2024	38	(43)	(5)	0	0	0	(5)
2025	38	(44)	(5)	0	0	0	(5)
2026	39	(44)	(5)	0	0	0	(5)
2027	40	(44)	(4)	0	0	0	(4)
2028	40	(44)	(4)	0	0	0	(4)
2029	41	(44)	(4)	0	0	0	(4)
2030	41	(45)	(3)	0	0	0	(3)
2031	42	(45)	(3)	0	0	0	(3)
2032	42	(45)	(3)	0	0	0	(3)
2033	43	(45)	(2)	0	0	0	(2)
2034	44	(46)	(2)	0	0	0	(2)
2035	44	(46)	(2)	0	0	0	(2)
2036	45	(46)	(1)	0	0	0	(1)
2037	45	(47)	(1)	0	0	0	(1)
2038	46	(47)	(1)	0	0	0	(1)
2039	47	(47)	(0)	0	0	0	(0)
2040	47	(47)	(0)	0	0	0	(0)
2041	48	(48)	(0)	0	0	0	(0)
2042	49	(49)	(0)	0	0	0	(0)
2043	49	(49)	(0)	0	0	0	(0)
2044	50	(50)	0	0	0	0	0
2045	51	(51)	0	0	0	0	0
2046	51	(51)	0	0	0	0	0
2047	52	(52)	0	0	0	0	0
2048	53	(53)	0	0	0	0	0
2049	53	(53)	0	0	0	0	0
2050	54	(54)	0	0	0	0	0
2051	55	(55)	0	0	0	0	0
2052	55	(55)	0	0	0	0	0
2053	56	(56)	0	0	0	0	0
2054	57	(57)	0	0	0	0	0
2055	58	(57)	0	0	0	0	0
2056	58	(58)	0	0	0	0	0
2057	59	(59)	0	0	0	0	0
2058	60	(59)	1	0	0	0	1
2059	61	(60)	1	0	0	0	1
2060	61	(61)	1	0	0	0	1
2061	62	(61)	1	3	0	3	(2)
2062	63	(62)	1	5	0	5	(4)
2063	64	(63)	1	8	0	8	(7)
2064	64	(63)	1	11	0	11	(10)
2065	65	(64)	1	13	0	13	(12)
2066	66	(65)	1	16	0	16	(15)
2067	67	(65)	1	19	0	19	(17)
2068	67	(66)	1	21	0	21	(20)
2069	68	(67)	2	24	0	24	(22)
2070	69	(67)	2	27	0	27	(25)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Crystal Clear SUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	122	0	0	0
1	2015	16,192	119	17	(29)	(46)
2	2016	16,274	116	33	(8)	(41)
3	2017	16,355	114	50	(8)	(58)
4	2018	16,437	111	67	(7)	(75)
5-year Goal	2019	16,518	108	84	(7)	(91)
6	2020	16,600	107	91	(7)	(98)
7	2021	16,690	106	97	(6)	(104)
8	2022	16,780	105	104	(6)	(110)
9	2023	16,870	104	111	(6)	(117)
10-year Goal	2024	16,960	103	118	(5)	(123)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Crystal Clear SUD’s most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility’s baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility’s five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility’s established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	22	0	0	0
1	2015	16,192	21	7	(41)	(48)
2	2016	16,274	20	14	(42)	(56)
3	2017	16,355	18	21	(42)	(63)
4	2018	16,437	17	29	(42)	(71)
5-year Goal	2019	16,518	16	36	(42)	(78)
6	2020	16,600	16	38	(42)	(80)
7	2021	16,690	16	39	(43)	(82)
8	2022	16,780	15	40	(43)	(83)
9	2023	16,870	15	42	(43)	(85)
10-year Goal	2024	16,960	15	43	(43)	(87)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of (41) MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 8.0% increase in 2015
        ii. 13.56% increase in 2016
    b. Estimated customer demand reduction of 4.31%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015	12.3	12
2016	33.6	34
2017	34.1	34
2018	34.6	35
2019	35.2	35
2020	35.7	36
2021	36.3	36
2022	36.8	37
2023	37.4	37
2024	37.9	38
2025	38.5	38
2026	39.0	39
2027	39.6	40
2028	40.1	40
2029	40.7	41
2030	41.2	41
2031	41.8	42
2032	42.5	42
2033	43.1	43
2034	43.7	44
2035	44.3	44
2036	44.9	45
2037	45.5	45
2038	46.1	46
2039	46.7	47
2040	47.3	47
2041	48.0	48
2042	48.6	49
2043	49.3	49
2044	50.0	50
2045	50.7	51
2046	51.3	51
2047	52.0	52
2048	52.7	53
2049	53.3	53
2050	54.0	54
2051	54.7	55
2052	55.5	55
2053	56.2	56
2054	56.9	57
2055	57.7	58
2056	58.4	58
2057	59.1	59
2058	59.9	60
2059	60.6	61
2060	61.3	61
2061	62.1	62
2062	62.9	63
2063	63.6	64
2064	64.4	64
2065	65.1	65
2066	65.9	66
2067	66.7	67
2068	67.4	67
2069	68.2	68
2070	69.0	69

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	22.00	0
2015	16,192	29.00	(41)
2016	16,274	29.00	(42)
2017	16,355	29.00	(42)
2018	16,437	29.00	(42)
2019	16,518	29.00	(42)
2020	16,600	29.00	(42)
2021	16,690	29.00	(43)
2022	16,780	29.00	(43)
2023	16,870	29.00	(43)
2024	16,960	29.00	(43)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
  - **a.** Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - i. Average Region L savings
    - ii. Specific percentage of outdoor usage unknown for your utility at this time
  - **b.** Savings could be 48 MG per year with current demand.
  - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	34	(42)	(8)	48	0	0	0	40
2017	34	(42)	(8)	48	0	0	0	41
2018	35	(42)	(7)	49	0	0	0	42
2019	35	(42)	(7)	50	0	0	0	43
2020	36	(42)	(7)	51	0	0	0	44
2021	36	(43)	(6)	51	0	0	0	45
2022	37	(43)	(6)	52	0	0	0	46
2023	37	(43)	(6)	53	0	0	0	47
2024	38	(43)	(5)	54	0	0	0	48
2025	38	(44)	(5)	55	0	0	0	50
2026	39	(44)	(5)	55	0	0	0	51
2027	40	(44)	(4)	56	0	0	0	52
2028	40	(44)	(4)	57	0	0	0	53
2029	41	(44)	(4)	58	0	0	0	54
2030	41	(45)	(3)	58	0	0	0	55
2031	42	(45)	(3)	59	0	0	0	56
2032	42	(45)	(3)	60	0	0	0	57
2033	43	(45)	(2)	61	0	0	0	59
2034	44	(46)	(2)	62	0	0	0	60
2035	44	(46)	(2)	63	0	0	0	61
2036	45	(46)	(1)	64	0	0	0	62
2037	45	(47)	(1)	64	0	0	0	63
2038	46	(47)	(1)	65	0	0	0	65
2039	47	(47)	(0)	66	0	0	0	66
2040	47	(47)	(0)	67	0	0	0	67

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	34	(42)	(8)	10	0	0	0	2
2017	34	(42)	(8)	11	0	0	0	3
2018	35	(42)	(7)	11	0	0	0	3
2019	35	(42)	(7)	11	0	0	0	4
2020	36	(42)	(7)	11	0	0	0	4
2021	36	(43)	(6)	11	0	0	0	5
2022	37	(43)	(6)	11	0	0	0	5
2023	37	(43)	(6)	12	0	0	0	6
2024	38	(43)	(5)	12	0	0	0	6
2025	38	(44)	(5)	12	0	0	0	7
2026	39	(44)	(5)	12	0	0	0	7
2027	40	(44)	(4)	12	0	0	0	8
2028	40	(44)	(4)	12	0	0	0	8
2029	41	(44)	(4)	13	0	0	0	9
2030	41	(45)	(3)	13	0	0	0	9
2031	42	(45)	(3)	13	0	0	0	10
2032	42	(45)	(3)	13	0	0	0	10
2033	43	(45)	(2)	13	0	0	0	11
2034	44	(46)	(2)	14	0	0	0	11
2035	44	(46)	(2)	14	0	0	0	12
2036	45	(46)	(1)	14	0	0	0	13
2037	45	(47)	(1)	14	0	0	0	13
2038	46	(47)	(1)	14	0	0	0	14
2039	47	(47)	(0)	15	0	0	0	14
2040	47	(47)	(0)	15	0	0	0	15

3. Rain Barrels
    - **a.** In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    - **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Hondo Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Hondo's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Hondo's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Hondo's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Hondo with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	120	(57)	63	13	0	13	51
2016	157	(57)	100	16	0	16	84
2017	158	(58)	100	16	0	16	84
2018	159	(59)	101	19	0	19	82
2019	161	(59)	101	22	0	22	79
2020	162	(60)	102	28	0	28	73
2021	163	(61)	102	34	0	34	68
2022	164	(61)	103	39	0	39	64
2023	166	(62)	104	45	0	45	59
2024	167	(63)	104	51	0	51	54
2025	168	(63)	105	56	0	56	49
2026	169	(64)	106	62	0	62	44
2027	171	(64)	106	67	0	67	39
2028	172	(65)	107	73	0	73	34
2029	173	(66)	108	79	0	79	29
2030	174	(66)	108	84	0	84	24
2031	175	(67)	109	90	0	90	19
2032	176	(67)	109	96	0	96	13
2033	178	(68)	110	102	0	102	7
2034	179	(68)	110	109	0	109	2
2035	180	(69)	111	115	0	115	(4)
2036	181	(69)	112	121	0	121	(9)
2037	182	(70)	112	127	0	127	(15)
2038	183	(70)	113	133	0	133	(20)
2039	184	(71)	113	139	0	139	(26)
2040	185	(71)	114	145	0	145	(31)
2041	186	(72)	114	150	0	150	(36)
2042	187	(72)	115	155	0	155	(40)
2043	188	(72)	116	160	0	160	(44)
2044	189	(73)	116	165	0	165	(48)
2045	190	(73)	117	169	0	169	(53)
2046	191	(74)	117	174	0	174	(57)
2047	192	(74)	118	179	0	179	(61)
2048	193	(75)	118	184	0	184	(65)
2049	194	(75)	119	188	0	188	(70)
2050	195	(76)	120	193	0	193	(74)
2051	196	(76)	120	196	0	196	(76)
2052	197	(76)	121	198	0	198	(77)
2053	198	(77)	121	201	0	201	(79)
2054	199	(77)	122	203	0	203	(81)
2055	200	(77)	122	206	0	206	(83)
2056	201	(78)	123	208	0	208	(85)
2057	202	(78)	124	211	0	211	(87)
2058	203	(79)	124	213	0	213	(89)
2059	204	(79)	125	216	0	216	(91)
2060	205	(79)	125	218	0	218	(93)
2061	206	(80)	126	221	0	221	(95)
2062	207	(80)	127	223	0	223	(97)
2063	208	(80)	127	226	0	226	(99)
2064	208	(81)	128	228	0	228	(101)
2065	209	(81)	128	231	0	231	(103)
2066	210	(82)	129	233	0	233	(105)
2067	211	(82)	129	236	0	236	(107)
2068	212	(82)	130	238	0	238	(109)
2069	213	(83)	130	241	0	241	(111)
2070	214	(83)	131	243	0	243	(113)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Hondo's quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	176	0	0	0
1	2014	9,061	176	1	0	(1)
2	2015	9,119	175	3	63	60
3	2016	9,236	175	4	100	96
4	2017	9,352	174	5	100	95
5-year Goal	2018	9,469	174	7	101	94
6	2019	9,585	174	8	101	94
7	2020	9,702	174	8	102	93
8	2021	9,797	173	9	102	93
9	2022	9,892	173	10	103	93
10-year Goal	2023	9,988	173	11	104	93

13 In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Hondo's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	27.00	0	0	0
1	2014	9,061	26.80	1	(56)	(57)
2	2015	9,119	26.60	1	(57)	(58)
3	2016	9,236	26.40	2	(57)	(59)
4	2017	9,352	26.20	3	(58)	(61)
5-year Goal	2018	9,469	26.00	3	(59)	(62)
6	2019	9,585	25.80	4	(59)	(64)
7	2020	9,702	25.60	5	(60)	(65)
8	2021	9,797	25.40	6	(61)	(67)
9	2022	9,892	25.20	6	(61)	(68)
10-year Goal	2023	9,988	25.00	7	(62)	(69)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 57 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 100% increase in residential and 25.67% increase for commercial in 2015
        ii. 30% increase in residential and 20% increase for commercial in 2016
    b. Estimated customer demand reduction of 24.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015	119.7	120
2016	157.0	157
2017	158.2	158
2018	159.4	159
2019	160.7	161
2020	161.9	162
2021	163.2	163
2022	164.4	164
2023	165.6	166
2024	166.9	167
2025	168.1	168
2026	169.3	169
2027	170.6	171
2028	171.8	172
2029	173.1	173
2030	174.3	174
2031	175.4	175
2032	176.4	176
2033	177.5	178
2034	178.6	179
2035	179.7	180
2036	180.7	181
2037	181.8	182
2038	182.9	183
2039	184.0	184
2040	185.0	185
2041	186.0	186
2042	187.0	187
2043	188.0	188
2044	189.0	189
2045	190.0	190
2046	191.0	191
2047	192.0	192
2048	193.0	193
2049	194.0	194
2050	195.0	195
2051	196.0	196
2052	197.0	197
2053	198.0	198
2054	199.0	199
2055	200.0	200
2056	201.0	201
2057	201.9	202
2058	202.9	203
2059	203.9	204
2060	204.9	205
2061	205.8	206
2062	206.7	207
2063	207.5	208
2064	208.4	208
2065	209.3	209
2066	210.2	210
2067	211.1	211
2068	212.0	212
2069	212.8	213
2070	213.7	214

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	27.00	0
2015	9,119	44.00	(57)
2016	9,236	44.00	(57)
2017	9,352	44.00	(58)
2018	9,469	44.00	(59)
2019	9,585	44.00	(59)
2020	9,702	44.00	(60)
2021	9,797	44.00	(61)
2022	9,892	44.00	(61)
2023	9,988	44.00	(62)
2024	10,083	44.00	(63)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region L savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 40 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	157	(57)	100	40	16	0	16	124
2017	158	(58)	100	40	16	0	16	124
2018	159	(59)	101	40	19	0	19	122
2019	161	(59)	101	41	22	0	22	120
2020	162	(60)	102	41	28	0	28	114
2021	163	(61)	102	41	34	0	34	110
2022	164	(61)	103	42	39	0	39	105
2023	166	(62)	104	42	45	0	45	100
2024	167	(63)	104	42	51	0	51	96
2025	168	(63)	105	42	56	0	56	91
2026	169	(64)	106	43	62	0	62	87
2027	171	(64)	106	43	67	0	67	82
2028	172	(65)	107	43	73	0	73	77
2029	173	(66)	108	44	79	0	79	73
2030	174	(66)	108	44	84	0	84	68
2031	175	(67)	109	44	90	0	90	63
2032	176	(67)	109	45	96	0	96	58
2033	178	(68)	110	45	102	0	102	52
2034	179	(68)	110	45	109	0	109	47
2035	180	(69)	111	45	115	0	115	42
2036	181	(69)	112	46	121	0	121	36
2037	182	(70)	112	46	127	0	127	31
2038	183	(70)	113	46	133	0	133	26
2039	184	(71)	113	46	139	0	139	21
2040	185	(71)	114	47	145	0	145	15

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	157	(57)	100	1	16	0	16	85
2017	158	(58)	100	1	16	0	16	85
2018	159	(59)	101	1	19	0	19	83
2019	161	(59)	101	1	22	0	22	80
2020	162	(60)	102	1	28	0	28	74
2021	163	(61)	102	1	34	0	34	69
2022	164	(61)	103	1	39	0	39	65
2023	166	(62)	104	1	45	0	45	60
2024	167	(63)	104	1	51	0	51	55
2025	168	(63)	105	1	56	0	56	50
2026	169	(64)	106	1	62	0	62	45
2027	171	(64)	106	1	67	0	67	40
2028	172	(65)	107	1	73	0	73	35
2029	173	(66)	108	1	79	0	79	30
2030	174	(66)	108	1	84	0	84	25
2031	175	(67)	109	1	90	0	90	20
2032	176	(67)	109	1	96	0	96	14
2033	178	(68)	110	1	102	0	102	9
2034	179	(68)	110	1	109	0	109	3
2035	180	(69)	111	1	115	0	115	(3)
2036	181	(69)	112	1	121	0	121	(8)
2037	182	(70)	112	1	127	0	127	(14)
2038	183	(70)	113	1	133	0	133	(19)
2039	184	(71)	113	1	139	0	139	(25)
2040	185	(71)	114	1	145	0	145	(30)

3. Rain Barrels

a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of New Braunfels Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares New Braunfels' current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) New Braunfels' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in New Braunfels' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report..

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for New Braunfels with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<ins>Actual Current Conservation Activity Savings</ins> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	17	0	17	93	0	93	(76)
2016	40	0	40	117	0	117	(76)
2017	62	0	62	117	0	117	(54)
2018	62	0	62	140	0	140	(78)
2019	63	0	63	163	0	163	(100)
2020	63	0	63	210	0	210	(146)
2021	64	0	64	260	0	260	(196)
2022	65	0	65	310	0	310	(245)
2023	66	0	66	359	0	359	(293)
2024	67	0	67	409	0	409	(342)
2025	68	0	68	459	0	459	(391)
2026	69	0	69	509	0	509	(440)
2027	70	0	70	559	0	559	(489)
2028	71	0	71	609	0	609	(538)
2029	72	0	72	659	0	659	(587)
2030	73	0	73	709	0	709	(636)
2031	74	0	74	776	0	776	(702)
2032	75	0	75	843	0	843	(768)
2033	76	0	76	910	0	910	(834)
2034	77	0	77	977	0	977	(900)
2035	78	0	78	1,045	0	1,045	(966)
2036	80	0	80	1,112	0	1,112	(1,032)
2037	81	0	81	1,179	0	1,179	(1,098)
2038	82	0	82	1,246	0	1,246	(1,165)
2039	83	0	83	1,314	0	1,314	(1,231)
2040	84	0	84	1,381	0	1,381	(1,297)
2041	85	0	85	1,426	0	1,426	(1,341)
2042	86	0	86	1,471	0	1,471	(1,385)
2043	87	0	87	1,516	0	1,516	(1,429)
2044	89	0	89	1,562	0	1,562	(1,473)
2045	90	0	90	1,607	0	1,607	(1,517)
2046	91	0	91	1,652	0	1,652	(1,561)
2047	92	0	92	1,697	0	1,697	(1,605)
2048	93	0	93	1,742	0	1,742	(1,649)
2049	94	0	94	1,788	0	1,788	(1,693)
2050	95	0	95	1,833	0	1,833	(1,738)
2051	96	0	96	1,875	0	1,875	(1,779)
2052	98	0	98	1,918	0	1,918	(1,820)
2053	99	0	99	1,961	0	1,961	(1,862)
2054	100	0	100	2,003	0	2,003	(1,903)
2055	101	0	101	2,046	0	2,046	(1,945)
2056	102	0	102	2,089	0	2,089	(1,986)
2057	103	0	103	2,131	0	2,131	(2,028)
2058	105	0	105	2,174	0	2,174	(2,069)
2059	106	0	106	2,217	0	2,217	(2,111)
2060	107	0	107	2,259	0	2,259	(2,152)
2061	108	0	108	2,305	0	2,305	(2,197)
2062	109	0	109	2,351	0	2,351	(2,242)
2063	110	0	110	2,397	0	2,397	(2,287)
2064	111	0	111	2,443	0	2,443	(2,332)
2065	112	0	112	2,490	0	2,490	(2,377)
2066	113	0	113	2,536	0	2,536	(2,422)
2067	115	0	115	2,582	0	2,582	(2,467)
2068	116	0	116	2,628	0	2,628	(2,512)
2069	117	0	117	2,674	0	2,674	(2,557)
2070	118	0	118	2,720	0	2,720	(2,602)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how New Braunfels quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	168	0	0	0
1	2015	70,543	165	88	17	(70)
2	2016	71,031	161	176	40	(136)
3	2017	71,519	158	266	62	(204)
4	2018	72,006	154	357	62	(295)
5-year Goal	2019	72,494	151	450	63	(387)
6	2020	72,982	150	479	63	(416)
7	2021	74,745	149	518	64	(454)
8	2022	76,507	148	559	65	(493)
9	2023	78,270	147	600	66	(534)
10-year Goal	2024	80,033	146	643	67	(576)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how New Braunfels' most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	168	0	0	0
1	2015	0	165	0	17	17
2	2016	5-year Goal	161	0	40	40
3	2017	6	158	0	62	62
4	2018	7	154	0	62	62
5-year Goal	2019	8	0	0	63	62
6	2020	9	-1	1	63	63
7	2021	10-year Goal	-2	0	64	64
8	2022	0	-3	0	65	65
9	2023	0	-4	0	66	66
10-year Goal	2024	0	0	0	67	67

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 0 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 2.5% increase in 2016
        ii. 2.5% increase in 2017
    b. Estimated customer demand reduction of 1.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. Outdoor Landscape Evaluations (SF)

a. 786 outdoor evaluations performed since 2010
b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005; Whitcomb, 2000)
    i. Assumed 75% savings from typical indoor and outdoor survey when only outdoor watering is evaluated
c. Approximately 22 gallons per day
d. Greater savings during peak periods
e. Lesser savings during off-peak periods
f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

7. Rain Barrels

a. In Region L, estimated savings of 18 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
b. 42,214 gallons of capacity issued from 2011 – 2016
c. Amount of capacity issued each year provided by staff
d. Estimated 10-year useful life for most barrels

8. High Efficiency (HE) Toilet Replacement Program (SF/MF)

a. 604 toilets replaced between 2010 – 2015
b. Number of toilets per year provided by staff
c. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
d. MF toilet replacements could save more, but without knowing how many were replaced for SF/MF customers, chose conservative estimate for SF for all replacements
e. Savings carry on indefinitely because replacement toilet will be as efficient

9. Clotheswasher Replacement Program (SF)

a. 1,001 rebates issued from 2010 – 2016
b. Rebates per year provided by staff
c. Estimated 7,030 gallons per year per washer (A&N Technical Services, 2005; THELMA, 1997)
d. 11-year useful life
e. Savings carry on indefinitely because replacement washer will be equally as efficient due to plumbing code and efficiency standards

10. Patio Replacement

a. Used EPA WaterSense Water Budget Tool Formula[19] with baseline 2,160 sq. ft. replacement area for SF residential customers.
b. 100 sq. ft. ratio in the formula yields 2,386 gallons per year per 100 sq. ft. of replacement
c. Assumed patio stays for the life of the home
d. Total of 156,000 sq. ft. replaced from 2014 – 2016

11. Mulch Replacement

a. Used EPA WaterSense Water Budget Tool Formula[20] with baseline 2,160 sq. ft. replacement area for SF residential customers.
b. 100 sq. ft. ratio in the formula yields 2,386 gallons per year per 100 sq. ft. of replacement
c. Conservatively assumed 10-year useful life
    i. Assumed mulch may be replaced by next home owner
d. Total of 1,055,000 sq. ft. replaced from 2014 – 2016

12. Grass Removal (Turf Replacement)

a. Used EPA WaterSense Water Budget Tool Formula[21] with baseline 2,160 sq. ft. replacement area for SF residential customers.
b. 100 sq. ft. ratio in the formula yields 2,386 gallons per year per 100 sq. ft. of replacement
c. Conservatively assumed 10-year useful life
    i. Assumed turf may be replaced by next home owner
d. Total of 495,000 sq. ft. replaced from 2015 – 2016

13. Measures Not Quantified

a. Irrigation — cap on either zones or whole system
b. Customer outreach program to customers with continuous consumption
c. Help finding leaks with new irrigation meters
d. 2007 Ordinance containing:
    i. Time of day water restrictions
    ii. Annual irrigation system analysis for sports fields and other large properties requiring a watering variance
    iii. Cooling towers must have a minimum of 4 cycles of concentration
    iv. New developments must include a model home with certain landscape requirements such as 50% turf.

NOTE: Items under No. 13 help explain disparity (Table 2-5) **between New Braunfels' low GPCD—which is achieving WMS supply volume GPCD targets and 5- and 10-year conservation plan goals—and the activities that the study could confidently measure and quantify. In addition, TWDB's 2011 baseline GPCD of 191 is abnormally high compared to**

[19] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$
[20] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$
[21] $LWR_H = RTM\ [(ET_o \times K_L) - R_a] \times A \times C_u$

average GPCD levels for the utility, making WMS supply volumes steep for a utility of this size.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Outdoor Landscape Evaluations (SF)	HE Clothes Washer Rebates (SF)	HE Toilet Rebates (SF/MF)	Rain Barrels	Patio Replacement (100 sq. ft.)	Mulch Replacement (Cubic Yards)	Grass Removal (100 sq. ft.)	Commercial Toilet/Urinal (ICI)	TOTAL SAVINGS
2009										0
2010		0.1	1.8	1.2						3.0
2011		1.0	2.8	2.1	0.0					6.0
2012		1.9	3.3	2.8	0.1					8.1
2013		2.5	4.5	3.8	0.2					11.0
2014		2.8	5.9	4.6	0.3	0.1	1.1			13.7
2015		3.3	6.9	6.3	0.6	0.3	1.9	0.7		17.3
2016	22	3.8	7.0	6.3	0.8	0.4	2.5	1.2		40.4
2017	45	2.3	7.0	6.3	0.8	0.4	2.5	1.2		62.1
2018	46	1.5	7.0	6.3	0.8	0.4	2.5	1.2		62.4
2019	48	0.9	7.0	6.3	0.8	0.4	2.5	1.2		62.9
2020	49	0.4	7.0	6.3	0.8	0.4	2.5	1.2		63.4
2021	50		7.0	6.3	0.7	0.4	2.5	1.2		64.1
2022	51		7.0	6.3	0.6	0.4	2.5	1.2		65.0
2023	52		7.0	6.3	0.6	0.4	2.5	1.2		66.1
2024	53		7.0	6.3	0.4	0.4	1.5	1.2		67.0
2025	54		7.0	6.3	0.1	0.4	0.7	0.5		67.7
2026	55		7.0	6.3		0.4				68.7
2027	56		7.0	6.3		0.4				69.8
2028	57		7.0	6.3		0.4				70.8
2029	58		7.0	6.3		0.4				71.9
2030	59		7.0	6.3		0.4				73.0
2031	60		7.0	6.3		0.4				74.1
2032	61		7.0	6.3		0.4				75.2
2033	63		7.0	6.3		0.4				76.3
2034	64		7.0	6.3		0.4				77.4
2035	65		7.0	6.3		0.4				78.5
2036	66		7.0	6.3		0.4				79.6
2037	67		7.0	6.3		0.4				80.7
2038	68		7.0	6.3		0.4				81.8
2039	69		7.0	6.3		0.4				82.9
2040	70		7.0	6.3		0.4				84.0
2041	71		7.0	6.3		0.4				85.2
2042	73		7.0	6.3		0.4				86.3
2043	74		7.0	6.3		0.4				87.4
2044	75		7.0	6.3		0.4				88.6
2045	76		7.0	6.3		0.4				89.7
2046	77		7.0	6.3		0.4				90.8
2047	78		7.0	6.3		0.4				92.0
2048	79		7.0	6.3		0.4				93.1
2049	81		7.0	6.3		0.4				94.2
2050	82		7.0	6.3		0.4				95.3
2051	83		7.0	6.3		0.4				96.5
2052	84		7.0	6.3		0.4				97.6
2053	85		7.0	6.3		0.4				98.8
2054	86		7.0	6.3		0.4				99.9
2055	87		7.0	6.3		0.4				101.1
2056	89		7.0	6.3		0.4				102.2
2057	90		7.0	6.3		0.4				103.4
2058	91		7.0	6.3		0.4				104.5
2059	92		7.0	6.3		0.4				105.7
2060	93		7.0	6.3		0.4				106.8
2061	94		7.0	6.3		0.4				107.9
2062	95		7.0	6.3		0.4				109.0
2063	96		7.0	6.3		0.4				110.1
2064	98		7.0	6.3		0.4				111.2
2065	99		7.0	6.3		0.4				112.4
2066	100		7.0	6.3		0.4				113.5
2067	101		7.0	6.3		0.4				114.6
2068	102		7.0	6.3		0.4				115.7
2069	103		7.0	6.3		0.4				116.8
2070	104		7.0	6.3		0.4				117.9

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	20.00	0
2015	70,543	20.00	0
2016	71,031	20.00	0
2017	71,519	20.00	0
2018	72,006	20.00	0
2019	72,494	20.00	0
2020	72,982	20.00	0
2021	74,745	20.00	0
2022	76,507	20.00	0
2023	78,270	20.00	0
2024	80,033	20.00	0

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 6.74% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 299 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	40	0	40	299	117	0	117	222
2017	62	0	62	306	117	0	117	251
2018	62	0	62	313	140	0	140	236
2019	63	0	63	320	163	0	163	220
2020	63	0	63	327	210	0	210	181
2021	64	0	64	335	260	0	260	139
2022	65	0	65	342	310	0	310	97
2023	66	0	66	349	359	0	359	56
2024	67	0	67	356	409	0	409	14
2025	68	0	68	364	459	0	459	(28)
2026	69	0	69	371	509	0	509	(70)
2027	70	0	70	378	559	0	559	(111)
2028	71	0	71	385	609	0	609	(153)
2029	72	0	72	392	659	0	659	(194)
2030	73	0	73	400	709	0	709	(236)
2031	74	0	74	407	776	0	776	(295)
2032	75	0	75	414	843	0	843	(353)
2033	76	0	76	422	910	0	910	(412)
2034	77	0	77	429	977	0	977	(471)
2035	78	0	78	437	1,045	0	1,045	(529)
2036	80	0	80	444	1,112	0	1,112	(588)
2037	81	0	81	452	1,179	0	1,179	(647)
2038	82	0	82	459	1,246	0	1,246	(705)
2039	83	0	83	467	1,314	0	1,314	(764)
2040	84	0	84	474	1,381	0	1,381	(823)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[22]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[22] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	40	0	40	59	117	0	117	(17)
2017	62	0	62	61	117	0	117	6
2018	62	0	62	62	140	0	140	(15)
2019	63	0	63	64	163	0	163	(37)
2020	63	0	63	65	210	0	210	(81)
2021	64	0	64	67	260	0	260	(129)
2022	65	0	65	68	310	0	310	(177)
2023	66	0	66	69	359	0	359	(224)
2024	67	0	67	71	409	0	409	(272)
2025	68	0	68	72	459	0	459	(319)
2026	69	0	69	74	509	0	509	(367)
2027	70	0	70	75	559	0	559	(414)
2028	71	0	71	77	609	0	609	(461)
2029	72	0	72	78	659	0	659	(509)
2030	73	0	73	79	709	0	709	(556)
2031	74	0	74	81	776	0	776	(621)
2032	75	0	75	82	843	0	843	(685)
2033	76	0	76	84	910	0	910	(750)
2034	77	0	77	85	977	0	977	(815)
2035	78	0	78	87	1,045	0	1,045	(879)
2036	80	0	80	88	1,112	0	1,112	(944)
2037	81	0	81	90	1,179	0	1,179	(1,009)
2038	82	0	82	91	1,246	0	1,246	(1,073)
2039	83	0	83	93	1,314	0	1,314	(1,138)
2040	84	0	84	94	1,381	0	1,381	(1,203)

Statewide Water Conservation Quantification Project
City of Sabinal Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sabinal's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Sabinal's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sabinal's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sabinal with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	(32)	(32)	3	0	3	(35)
2016	0	(32)	(32)	4	0	4	(36)
2017	0	(33)	(33)	4	0	4	(36)
2018	0	(33)	(33)	4	0	4	(37)
2019	0	(33)	(33)	5	0	5	(38)
2020	0	(34)	(34)	7	0	7	(40)
2021	0	(34)	(34)	8	0	8	(42)
2022	0	(34)	(34)	9	0	9	(43)
2023	0	(35)	(35)	10	0	10	(45)
2024	0	(35)	(35)	11	0	11	(46)
2025	0	(35)	(35)	13	0	13	(48)
2026	0	(36)	(36)	14	0	14	(49)
2027	0	(36)	(36)	15	0	15	(51)
2028	0	(36)	(36)	16	0	16	(53)
2029	0	(37)	(37)	17	0	17	(54)
2030	0	(37)	(37)	19	0	19	(56)
2031	0	(37)	(37)	20	0	20	(57)
2032	0	(38)	(38)	21	0	21	(59)
2033	0	(38)	(38)	22	0	22	(60)
2034	0	(38)	(38)	24	0	24	(62)
2035	0	(38)	(38)	25	0	25	(63)
2036	0	(39)	(39)	26	0	26	(65)
2037	0	(39)	(39)	28	0	28	(67)
2038	0	(39)	(39)	29	0	29	(68)
2039	0	(39)	(39)	30	0	30	(70)
2040	0	(40)	(40)	32	0	32	(71)
2041	0	(40)	(40)	33	0	33	(73)
2042	0	(40)	(40)	34	0	34	(75)
2043	0	(41)	(41)	36	0	36	(76)
2044	0	(41)	(41)	37	0	37	(78)
2045	0	(41)	(41)	39	0	39	(80)
2046	0	(41)	(41)	40	0	40	(82)
2047	0	(42)	(42)	42	0	42	(83)
2048	0	(42)	(42)	43	0	43	(85)
2049	0	(42)	(42)	45	0	45	(87)
2050	0	(42)	(42)	46	0	46	(88)
2051	0	(43)	(43)	47	0	47	(90)
2052	0	(43)	(43)	49	0	49	(92)
2053	0	(43)	(43)	50	0	50	(93)
2054	0	(44)	(44)	52	0	52	(95)
2055	0	(44)	(44)	53	0	53	(97)
2056	0	(44)	(44)	54	0	54	(98)
2057	0	(44)	(44)	56	0	56	(100)
2058	0	(45)	(45)	57	0	57	(102)
2059	0	(45)	(45)	59	0	59	(103)
2060	0	(45)	(45)	60	0	60	(105)
2061	0	(45)	(45)	61	0	61	(106)
2062	0	(46)	(46)	61	0	61	(107)
2063	0	(46)	(46)	62	0	62	(108)
2064	0	(46)	(46)	63	0	63	(109)
2065	0	(46)	(46)	63	0	63	(110)
2066	0	(47)	(47)	64	0	64	(111)
2067	0	(47)	(47)	65	0	65	(111)
2068	0	(47)	(47)	65	0	65	(112)
2069	0	(47)	(47)	66	0	66	(113)
2070	0	(48)	(48)	66	0	66	(114)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sabinal's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	169	0.0	0	0
1	2,015	1,750	169	0	(32)	(32)
2	2,016	1,770	169	0	(32)	(33)
3	2,017	1,791	168	0	(33)	(33)
4	2,018	1,811	168	1	(33)	(34)
5-year Goal	2,019	1,832	168	1	(33)	(34)
6	2,020	1,852	168	1	(34)	(35)
7	2,021	1,869	168	1	(34)	(35)
8	2,022	1,887	167	1	(34)	(36)
9	2,023	1,904	167	1	(35)	(36)
10-year Goal	2,024	1,922	167	1	(35)	(36)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sabinal's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2,015	1,750	9	0	(32)	(32)
2	2,016	1,770	9	0	(32)	(32)
3	2,017	1,791	9	0	(33)	(33)
4	2,018	1,811	9	0	(33)	(33)
5-year Goal	2,019	1,832	9	0	(33)	(33)
6	2,020	1,852	9	0	(34)	(34)
7	2,021	1,869	9	0	(34)	(34)
8	2,022	1,887	9	0	(34)	(34)
9	2,023	1,904	9	0	(35)	(35)
10-year Goal	2,024	1,922	9	0	(35)	(35)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Loss of 32 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	1,750	59.00	(32)
2016	1,770	59.00	(32)
2017	1,791	59.00	(33)
2018	1,811	59.00	(33)
2019	1,832	59.00	(33)
2020	1,852	59.00	(34)
2021	1,869	59.00	(34)
2022	1,887	59.00	(34)
2023	1,904	59.00	(35)
2024	1,922	59.00	(35)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 6.11% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region L savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 9 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(32)	(32)	9	4	0	4	(27)
2017	0	(33)	(33)	9	4	0	4	(28)
2018	0	(33)	(33)	9	4	0	4	(29)
2019	0	(33)	(33)	9	5	0	5	(30)
2020	0	(34)	(34)	9	7	0	7	(31)
2021	0	(34)	(34)	9	8	0	8	(33)
2022	0	(34)	(34)	9	9	0	9	(34)
2023	0	(35)	(35)	9	10	0	10	(36)
2024	0	(35)	(35)	9	11	0	11	(37)
2025	0	(35)	(35)	9	13	0	13	(39)
2026	0	(36)	(36)	9	14	0	14	(40)
2027	0	(36)	(36)	9	15	0	15	(42)
2028	0	(36)	(36)	9	16	0	16	(43)
2029	0	(37)	(37)	9	17	0	17	(45)
2030	0	(37)	(37)	9	19	0	19	(46)
2031	0	(37)	(37)	10	20	0	20	(48)
2032	0	(38)	(38)	10	21	0	21	(49)
2033	0	(38)	(38)	10	22	0	22	(51)
2034	0	(38)	(38)	10	24	0	24	(52)
2035	0	(38)	(38)	10	25	0	25	(54)
2036	0	(39)	(39)	10	26	0	26	(55)
2037	0	(39)	(39)	10	28	0	28	(57)
2038	0	(39)	(39)	10	29	0	29	(58)
2039	0	(39)	(39)	10	30	0	30	(60)
2040	0	(40)	(40)	10	32	0	32	(61)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

---

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(32)	(32)	2	4	0	4	(34)
2017	0	(33)	(33)	2	4	0	4	(34)
2018	0	(33)	(33)	2	4	0	4	(35)
2019	0	(33)	(33)	2	5	0	5	(37)
2020	0	(34)	(34)	2	7	0	7	(38)
2021	0	(34)	(34)	2	8	0	8	(40)
2022	0	(34)	(34)	2	9	0	9	(41)
2023	0	(35)	(35)	2	10	0	10	(43)
2024	0	(35)	(35)	2	11	0	11	(44)
2025	0	(35)	(35)	2	13	0	13	(46)
2026	0	(36)	(36)	2	14	0	14	(47)
2027	0	(36)	(36)	2	15	0	15	(49)
2028	0	(36)	(36)	2	16	0	16	(50)
2029	0	(37)	(37)	2	17	0	17	(52)
2030	0	(37)	(37)	2	19	0	19	(53)
2031	0	(37)	(37)	2	20	0	20	(55)
2032	0	(38)	(38)	2	21	0	21	(57)
2033	0	(38)	(38)	2	22	0	22	(58)
2034	0	(38)	(38)	2	24	0	24	(60)
2035	0	(38)	(38)	2	25	0	25	(61)
2036	0	(39)	(39)	2	26	0	26	(63)
2037	0	(39)	(39)	2	28	0	28	(64)
2038	0	(39)	(39)	2	29	0	29	(66)
2039	0	(39)	(39)	2	30	0	30	(68)
2040	0	(40)	(40)	2	32	0	32	(69)

3. Water Rate Increase
- **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
- **b.** Approximately 3 MG of savings per year with current demand
- **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
- **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	(32)	(32)	3	4	0	4	(33)
2017	0	(33)	(33)	3	4	0	4	(33)
2018	0	(33)	(33)	3	4	0	4	(35)
2019	0	(33)	(33)	3	5	0	5	(36)
2020	0	(34)	(34)	3	7	0	7	(37)
2021	0	(34)	(34)	3	8	0	8	(39)
2022	0	(34)	(34)	3	9	0	9	(40)
2023	0	(35)	(35)	3	10	0	10	(42)
2024	0	(35)	(35)	3	11	0	11	(43)
2025	0	(35)	(35)	3	13	0	13	(45)
2026	0	(36)	(36)	3	14	0	14	(46)
2027	0	(36)	(36)	3	15	0	15	(48)
2028	0	(36)	(36)	3	16	0	16	(49)
2029	0	(37)	(37)	3	17	0	17	(51)
2030	0	(37)	(37)	3	19	0	19	(52)
2031	0	(37)	(37)	3	20	0	20	(54)
2032	0	(38)	(38)	3	21	0	21	(56)
2033	0	(38)	(38)	3	22	0	22	(57)
2034	0	(38)	(38)	3	24	0	24	(59)
2035	0	(38)	(38)	3	25	0	25	(60)
2036	0	(39)	(39)	3	26	0	26	(62)
2037	0	(39)	(39)	3	28	0	28	(63)
2038	0	(39)	(39)	3	29	0	29	(65)
2039	0	(39)	(39)	3	30	0	30	(66)
2040	0	(40)	(40)	3	32	0	32	(68)

4. Rain Barrels

   a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

   b. Estimated 10-year useful life for most barrels

TWDB Statewide Water Conservation Quantification Project
San Antonio Water System Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, we first engaged with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

We then quantified each utility's conservation activities through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. Individual reports distributed to each participating utility detail these attributes. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares San Antonio Water System's (SAWS) current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) SAWS' own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in SAWS' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8 9]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. We are not aware of all activities that are ongoing. Some activities within a utility's service area are implemented on a micro-scale that we cannot yet quantify. Individual households and businesses may be implementing conservation measures that we do not know about and therefore cannot include in this report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because we used a single year (2015) value for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures we have carried forward in our model because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. Our approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for SAWS with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, excluding savings from water loss reduction. Because the regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, we have quantified utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-4.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	3,923	1,336	5,260	2,314	0	2,314	2,946
2016	4,470	1,350	5,819	2,892	0	2,892	2,927
2017	4,620	1,363	5,983	2,892	0	2,892	3,091
2018	4,605	1,376	5,981	3,471	0	3,471	2,511
2019	4,590	1,390	5,979	4,049	0	4,049	1,930
2020	4,610	1,403	6,013	5,206	0	5,206	807
2021	4,564	1,420	5,984	5,034	0	5,034	949
2022	4,575	1,437	6,012	4,862	0	4,862	1,149
2023	4,601	1,454	6,055	4,691	0	4,691	1,364
2024	4,633	1,471	6,104	4,519	0	4,519	1,585
2025	4,663	1,488	6,150	4,347	0	4,347	1,803
2026	3,906	1,505	5,411	4,175	0	4,175	1,235
2027	3,355	1,522	4,877	4,004	0	4,004	874
2028	2,940	1,539	4,479	3,832	0	3,832	647
2029	2,526	1,556	4,081	3,660	0	3,660	421
2030	2,111	1,573	3,683	3,488	0	3,488	195
2031	2,094	1,587	3,681	3,364	0	3,364	317
2032	2,077	1,602	3,679	3,241	0	3,241	439
2033	2,060	1,617	3,677	3,117	0	3,117	561
2034	2,044	1,631	3,675	2,993	0	2,993	683
2035	2,015	1,646	3,661	2,869	0	2,869	792
2036	1,846	1,661	3,507	2,745	0	2,745	762
2037	1,828	1,676	3,503	2,621	0	2,621	882
2038	1,818	1,690	3,508	2,497	0	2,497	1,011
2039	1,809	1,705	3,513	2,373	0	2,373	1,141
2040	1,799	1,720	3,519	2,249	0	2,249	1,270
2041	1,789	1,734	3,523	2,502	0	2,502	1,021
2042	1,780	1,748	3,528	2,755	0	2,755	772
2043	1,770	1,762	3,532	3,009	0	3,009	524
2044	1,761	1,776	3,537	3,262	0	3,262	275
2045	1,750	1,790	3,539	3,515	0	3,515	24
2046	1,752	1,804	3,556	3,768	0	3,768	(212)
2047	1,755	1,818	3,573	4,021	0	4,021	(448)
2048	1,758	1,832	3,590	4,275	0	4,275	(685)
2049	1,761	1,846	3,607	4,528	0	4,528	(921)
2050	1,764	1,860	3,624	4,781	0	4,781	(1,157)
2051	1,767	1,873	3,639	5,300	0	5,300	(1,660)
2052	1,769	1,885	3,655	5,818	0	5,818	(2,164)
2053	1,772	1,898	3,670	6,337	0	6,337	(2,667)
2054	1,775	1,911	3,686	6,856	0	6,856	(3,170)
2055	1,778	1,924	3,701	7,375	0	7,375	(3,673)
2056	1,781	1,936	3,717	7,893	0	7,893	(4,176)
2057	1,783	1,949	3,733	8,412	0	8,412	(4,680)
2058	1,786	1,962	3,748	8,931	0	8,931	(5,183)
2059	1,789	1,975	3,764	9,450	0	9,450	(5,686)
2060	1,792	1,987	3,779	9,968	0	9,968	(6,189)
2061	1,795	2,000	3,794	10,398	0	10,398	(6,604)
2062	1,797	2,012	3,809	10,828	0	10,828	(7,019)
2063	1,800	2,024	3,824	11,257	0	11,257	(7,434)
2064	1,802	2,036	3,839	11,687	0	11,687	(7,849)
2065	1,805	2,049	3,854	12,117	0	12,117	(8,263)
2066	1,808	2,061	3,868	12,547	0	12,547	(8,678)
2067	1,810	2,073	3,883	12,976	0	12,976	(9,093)
2068	1,813	2,085	3,898	13,406	0	13,406	(9,508)
2069	1,815	2,098	3,913	13,836	0	13,836	(9,923)
2070	1,818	2,110	3,928	14,266	0	14,266	(10,338)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how SAWS' quantified savings from its implemented activities compare with five- and goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer Section 5 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	143	0	0	0
1	2015	1,743,559	142	891	5,260	4,369
2	2016	1,760,871	140	1,800	5,819	4,020
3	2017	1,778,184	139	2,726	5,983	3,257
4	2018	1,795,496	137	3,670	5,981	2,311
5-year Goal	2019	1,812,809	136	4,632	5,979	1,347
6	2020	1,830,121	136	4,810	6,013	1,203
7	2021	1,852,286	136	5,003	5,984	981
8	2022	1,874,450	135	5,200	6,012	812
9	2023	1,896,615	135	5,400	6,055	655
10-year Goal	2024	1,918,780	135	5,603	6,104	501

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how SAWS' most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match five- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-4 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.10	0	0	0
1	2015	1,743,559	20.06	25	1,336	1,311
2	2016	1,760,871	20.02	51	1,350	1,298
3	2017	1,778,184	19.98	78	1,363	1,285
4	2018	1,795,496	19.94	105	1,376	1,271
5-year Goal	2019	1,812,809	19.90	132	1,390	1,257
6	2020	1,830,121	19.82	187	1,403	1,216
7	2021	1,852,286	19.74	243	1,420	1,176
8	2022	1,874,450	19.66	301	1,437	1,136
9	2023	1,896,615	19.58	360	1,454	1,094
10-year Goal	2024	1,918,780	19.50	420	1,471	1,051

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

For SAWS, staff provided savings for all activities implemented or enhanced from 2010 through 2015 (San Antonio Water System, 2016). We have used those estimates in this report, and, in some cases, have assumed annual decay rates and useful life for activities commonly employed by other utilities in the broader TWDB study. However, without knowing the full extent of every action performed for a "commercial outdoor consult," for example, these are simply assumptions. Utility staff may find that some assumed annual decay rates and useful life estimates attributed to these activities should be adjusted, but our intention was to be conservative with future savings projections.

In Tables 5-1, 5-2, and 5-3, all total savings figures reported each year by SAWS from 2010 through 2015 are also aggregated each year so that savings are cumulative. For example, the total for 2012 reflects savings of 2,427 MG, which is the sum of the department totals reported in 2010 (835.9 MG), 2011 (856.6 MG), and 2012 (734.2 MG).

In addition, during our interview and in other collected materials, SAWS staff emphasized that many indoor activities would largely be phased out—due to market saturation and other various reasons—and greater focus would be placed on outdoor activities. For this reason, we projected savings for most outdoor activities forward 10 years using similar savings achieved in past years.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). During the project, we were able to survey several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.

- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, we used a 50/50 savings split when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

4.1.1 Outdoor Activities

1. **Water Rate Increases (service area-wide activity)**
   a. Last two rate increases:
      i. 0.085% combined base rate increase
      ii. 0.078% combined volumetric rate increase
      iii. 0.163% overall increase with 50/50 weight given to base and volumetric rate increases = 0.17% of total demand
   b. Savings are cumulative and based on TWDB's Best Management Practices for Municipal Water Users Guide[15] (TWDB, 2013), as well as Environmental Protection Agency guidelines and other sources (U.S. EPA, 1998; Whitcomb, 1999)

2. **Home and Irrigation Consult**
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025 based on similar savings achieved through 2015
   c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)
   d. Decay rate applies starting in 2025

3. **Home (Only) Consult**
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025 based on similar savings achieved through 2015
   c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)
   d. Decay rate applies starting in 2025

[15] Water Conservation Advisory Council (WCAC) estimates 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.

4. **Irrigation (Only) Consult**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)

5. **Commercial Consult**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Savings projected through 2025 based on similar savings achieved through 2015
    c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)
    d. Decay rate applies starting in 2025

6. **Large Landscape Survey (5 acres)**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Savings projected through 2025 based on similar savings achieved through 2015
    c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)
    d. Decay rate applies starting in 2025

7. **E-newsletter**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Discontinued after 2012

8. **WaterSaver Landscape**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Savings projected through 2025
    c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)

9. **Top 1% Program**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Savings projected through 2025
    c. 20% annual decay rate attributed to customer behavior for similar programs (A&N Technical Services, 2005)

10. **Residential Irrigation Rebate**
    a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
    b. Savings projected through 2025
    c. Applied 20% annual decay rate starting in 2025

        i. If rebate primarily includes device(s), a useful life determination would be more applicable to savings estimate

11. Commercial Irrigation Rebate
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025
   c. Applied 20% annual decay rate starting in 2025
        i. If rebate primarily includes device(s), a useful life determination would be more applicable to savings estimate

12. Summer/Fall Coupons
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings of 8 MG only itemized for 2013 in materials, but value carried over to department totals reported in subsequent years
        i. Applied same value to 2014 and 2015 with no aggregation
   c. Did not assume annual decay rate or useful life because the activity appears discontinued

13. Patioscape Coupons
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025
   c. Assumed 20-year useful life

14. Landscape Coupons
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025
   c. Assumed 10-year useful life
        i. Similar to turf replacements

15. Rain Sensor Coupons
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings projected through 2025
   c. Assumed five-year useful life for sensors

4.1.2 Indoor Activities

16. High-efficiency (HE) Toilet Replacements for Single Family (SF) Customers
   a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
   b. Savings shown only through 2014
   c. Savings from that year forward carry on indefinitely because replacement fixture will be as efficient due to current plumbing code and efficiency standards

17. HE Toilet Replacements (Commercial)

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings shown only through 2014
c. Savings from that year forward carry on indefinitely because replacement fixture will be as efficient due to current plumbing code and efficiency standards

18. Hot Water on Demand Program

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Did not assume annual decay rate or useful life because the activity appears discontinued

19. HE Clothes Washer Rebates (SF)

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2010 only for this activity
c. 11-year useful life (A&N Technical Services, 2005; THELMA, 1997)

20. HE Clothes Washer Rebates (Commercial)

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2010 – 2013 only for this activity
c. 11-year useful life (A&N Technical Services, 2005; THELMA, 1997)

21. Waterless Urinals Commercial

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2012 only for this activity
c. Assumed that savings from that year forward carry on indefinitely because model will not be replaced by standard urinal

22. Fix-a-Leak Program

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2010 only for this activity
c. Assumed that savings from that year forward carry on indefinitely

23. Plumbers-to-People Program

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings quantified only through 2016
c. Assumed 20-year useful life for repairs and work performed by plumbers

24. Home Makeover Program

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)

b. Savings quantified only through 2016
c. Assumed 10-year useful life for work completed during makeover

25. Pool Filters

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2013 and 2014 only for this activity
c. Assumed 10-year useful life for pool filters

26. Custom Rebates (Commercial)

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2013 – 2015 only for this activity
c. Assumed 10-year useful life for item(s) rebated

27. Large Scale Retrofit

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2010 – 2012 only for this activity
c. Savings from that year forward carry on indefinitely because replacement fixtures assumed to be as efficient due to current plumbing code and efficiency standards

28. Indoor Audits

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings reported for 2012 – 2013 only for this activity
c. Assumed 10-year useful life

29. Showerhead/Aerator Program

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings shown only through 2016
c. Savings from that year forward carry on indefinitely because replacement fixtures will be as efficient due to current plumbing code and efficiency standards
    i. Did not parse aerator savings from showerhead savings

30. Water Waste Citations

a. Annual savings projections provided by SAWS (San Antonio Water System, 2016)
b. Savings projected only through 2016
c. 3-year useful life applied to this activity by other utilities in broader TWDB study

5 Summary of Savings

Table 5-1. Savings for All Activities Not Including Water Loss Reduction (MG).

Year	Savings for Outdoor Activities	Savings for Indoor Activities	TOTAL ACTIVITY SAVINGS
2010	342.1	493.7	836
2011	765.5	931.9	1,697
2012	1,183.1	1,243.7	2,427
2013	1,182.7	1,814.1	2,997
2014	1,490.1	2,027.5	3,518
2015	1,820.7	2,102.5	3,923
2016	2,276.2	2,193.3	4,470
2017	2,426.6	2,193.4	4,620
2018	2,447.0	2,158.0	4,605
2019	2,465.9	2,123.7	4,590
2020	2,486.3	2,123.7	4,610
2021	2,506.7	2,057.2	4,564
2022	2,542.6	2,032.5	4,575
2023	2,578.6	2,022.7	4,601
2024	2,614.5	2,018.3	4,633
2025	2,650.5	2,012.1	4,663
2026	2,235.5	1,670.6	3,906
2027	1,820.6	1,534.9	3,355
2028	1,405.5	1,534.9	2,940
2029	990.6	1,534.9	2,526
2030	575.7	1,534.9	2,111
2031	558.9	1,534.9	2,094
2032	542.2	1,534.9	2,077
2033	525.5	1,534.9	2,060
2034	508.8	1,534.9	2,044
2035	479.7	1,534.9	2,015
2036	450.7	1,395.6	1,846
2037	432.1	1,395.6	1,828
2038	422.4	1,395.6	1,818
2039	412.9	1,395.6	1,809
2040	403.3	1,395.6	1,799
2041	393.7	1,395.6	1,789
2042	384.3	1,395.6	1,780
2043	374.8	1,395.6	1,770
2044	365.2	1,395.6	1,761
2045	354.0	1,395.6	1,750
2046	356.8	1,395.6	1,752
2047	359.6	1,395.6	1,755
2048	362.5	1,395.6	1,758
2049	365.3	1,395.6	1,761
2050	368.1	1,395.6	1,764
2051	371.0	1,395.6	1,767
2052	373.8	1,395.6	1,769
2053	376.6	1,395.6	1,772
2054	379.4	1,395.6	1,775
2055	382.2	1,395.6	1,778
2056	385.0	1,395.6	1,781
2057	387.8	1,395.6	1,783
2058	390.6	1,395.6	1,786
2059	393.4	1,395.6	1,789
2060	396.3	1,395.6	1,792
2061	398.9	1,395.6	1,795
2062	401.5	1,395.6	1,797
2063	404.1	1,395.6	1,800
2064	406.7	1,395.6	1,802
2065	409.3	1,395.6	1,805
2066	411.9	1,395.6	1,808
2067	414.6	1,395.6	1,810
2068	417.2	1,395.6	1,813
2069	419.8	1,395.6	1,815
2070	422.4	1,395.6	1,818

Table 5-2. **Savings for Outdoor Activities (MG).**

Year	Water Rate Increases	Home and Irrigation Consult	Home (Only) Consult	Irrigation (Only) Consult	Commercial Consult	Large Landscape Survey (5-Acres)	E-Newsletter	WaterSaver Landscape	Top 1% Program	Residential Irrigation Rebate	Commercial Irrigation Rebate	Summer/Fall Coupons	Patioscape Coupons	Landscape Coupons	Rain Sensor Coupons	TOTAL SAVINGS
2010		46.2	12.1	4.3	14.1	169.7	85.4	1.1	9.3							342
2011		124.9	33.2	9.0	29.5	349.7	184.4	5.0	25.6	1.8	2.4					766
2012		196.0	45.9	12.7	44.9	529.7	296.5	1.7	44.8	5.2	5.8					1,183
2013		220.9	47.6	35.4	66.4	709.7		3.9	64.0	16.5	8.5	8.0	1.8			1,183
2014		220.9	47.6	77.8	121.9	883.1		17.5	64.0	26.8	10.2	8.0	1.8	9.0	1.5	1,490
2015		288.3	59.3	77.8	124.4	1,092.5		17.5	64.0	33.4	11.5	8.0	14.1	28.4	1.5	1,821
2016	142.3	355.6	71.0	77.8	126.8	1,292.5		17.5	64.0	40.1	12.8		26.5	47.9	1.5	2,276
2017	275.2	355.6	71.0	62.2	126.8	1,292.5		17.5	64.0	40.1	14.2		38.8	67.3	1.5	2,427
2018	278.1	355.6	71.0	46.7	126.8	1,292.5		17.5	64.0	40.1	15.5		51.1	86.8	1.5	2,447
2019	280.9	355.6	71.0	31.1	126.8	1,292.5		17.5	64.0	40.1	16.8		63.5	106.2		2,466
2020	283.8	355.6	71.0	15.6	126.8	1,292.5		17.5	64.0	40.1	18.1		75.8	125.7		2,486
2021	286.7	355.6	71.0		126.8	1,292.5		17.5	64.0	40.1	19.4		88.1	145.1		2,507
2022	289.5	355.6	71.0		126.8	1,292.5		17.5	64.0	40.1	20.7		100.5	164.5		2,543
2023	292.4	355.6	71.0		126.8	1,292.5		17.5	64.0	40.1	22.0		112.8	184.0		2,579
2024	295.3	355.6	71.0		126.8	1,292.5		17.5	64.0	40.1	23.3		125.1	203.4		2,615
2025	298.2	355.6	71.0		126.8	1,292.5		17.5	64.0	40.1	24.6		137.5	222.9		2,650
2026	301.0	284.5	56.8		101.5	1,034.0		14.0	51.2	32.0	19.7		137.5	203.4		2,236
2027	303.9	213.4	42.6		76.1	775.5		10.5	38.4	24.0	14.8		137.5	184.0		1,821
2028	306.8	142.2	28.4		50.7	517.0		7.0	25.6	16.0	9.8		137.5	164.5		1,406
2029	309.6	71.1	14.2		25.4	258.5		3.5	12.8	8.0	4.9		137.5	145.1		991
2030	312.5												137.5	125.7		576
2031	315.2												137.5	106.2		559
2032	318.0												137.5	86.8		542
2033	320.7												137.5	67.3		525
2034	323.4												137.5	47.9		509
2035	326.2												125.1	28.4		480
2036	328.9												112.8	9.0		451
2037	331.6												100.5			432
2038	334.3												88.1			422
2039	337.1												75.8			413
2040	339.8												63.5			403
2041	342.6												51.1			394
2042	345.5												38.8			384
2043	348.3												26.5			375
2044	351.1												14.1			365
2045	354.0															354
2046	356.8															357
2047	359.6															360
2048	362.5															362
2049	365.3															365
2050	368.1															368
2051	371.0															371
2052	373.8															374
2053	376.6															377
2054	379.4															379
2055	382.2															382
2056	385.0															385
2057	387.8															388
2058	390.6															391
2059	393.4															393
2060	396.3															396
2061	398.9															399
2062	401.5															401
2063	404.1															404
2064	406.7															407
2065	409.3															409
2066	411.9															412
2067	414.6															415
2068	417.2															417
2069	419.8															420
2070	422.4															422

Table 5-3. Savings for Indoor Activities (MG).

HE Toilets (SF)	HE Toilets Commercial	Hot Water on Demand Program	HE Clothes Washer Rebates (SF)	HE Clothes Washer Commercial	Waterless Urinals Commercial	Fix a Leak	Plumbers-to-People Program	Home Makeover Program	Pool Filter	Commercial Custom Rebate	Large Scale Retrofit	Indoor Audits	Showerhead/ Aerator Program	Water Waste Citations	TOTAL SAVINGS
115.0	91.9	0.4	66.5	6.4		23.4	27.9	21.7			65.1		75.5		494
193.6	207.1	0.8	66.5	31.1		23.4	51.9	36.4			205.0		116.1		932
266.4	267.8	1.1	66.5	37.1	44	23.4	74.6	52.1			245.8	42.0	122.8		1,244
403.3	304.2	1.1	66.5	41.3	44	23.4	104.6	129.0	3.8	72.0	245.8	116.3	258.9		1,814
436.3	342.6	1.1	66.5	41.1	44	23.4	132.1	135.5	4.0	139.0	245.8	116.3	299.9		2,027
436.3	342.7	1.1	66.5	41.1	44	23.4	135.7	135.6	4.0	174.2	245.8	116.3	301.7	34.3	2,103
436.3	342.7	1.1	66.5	41.1	44	23.4	139.3	135.6	4.0	225.2	245.8	116.3	303.4	68.6	2,193
436.3	342.7	1.1	66.5	41.1	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4	68.6	2,193
436.3	342.7		66.5	41.1	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4	34.3	2,158
436.3	342.7		66.5	41.1	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4		2,124
436.3	342.7		66.5	41.1	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4		2,124
436.3	342.7			41.1	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4		2,057
436.3	342.7			16.4	44	23.4	139.3	135.7	4.0	225.2	245.8	116.3	303.4		2,033
436.3	342.7			10.4	44	23.4	139.3	135.7	0.2	225.2	245.8	116.3	303.4		2,023
436.3	342.7			6.2	44	23.4	139.3	135.7		225.2	245.8	116.3	303.4		2,018
436.3	342.7				44	23.4	139.3	135.7		225.2	245.8	116.3	303.4		2,012
436.3	342.7				44	23.4	139.3	135.7			245.8		303.4		1,671
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4	139.3				245.8		303.4		1,535
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396
436.3	342.7				44	23.4					245.8		303.4		1,396

Table 5-4. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	20.10	0
2015	1,743,559	18.00	1,336
2016	1,760,871	18.00	1,350
2017	1,778,184	18.00	1,363
2018	1,795,496	18.00	1,376
2019	1,812,809	18.00	1,390
2020	1,830,121	18.00	1,403
2021	1,852,286	18.00	1,420
2022	1,874,450	18.00	1,437
2023	1,896,615	18.00	1,454
2024	1,918,780	18.00	1,471

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications.
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
  - ii. An online search suggested that WaterSmart may already be working with SAWS.
  - iii. WaterSmart conservatively estimates savings of 5% for customers receiving its Home Water Reports (East Bay Municipal Utility District, 2014).
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year.[16]

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	4,470	1,350	5,819	1,114	2,892	0	2,892	4,041
2017	4,620	1,363	5,983	1,126	2,892	0	2,892	4,217
2018	4,605	1,376	5,981	1,138	3,471	0	3,471	3,648
2019	4,590	1,390	5,979	1,149	4,049	0	4,049	3,079
2020	4,610	1,403	6,013	1,161	5,206	0	5,206	1,968
2021	4,564	1,420	5,984	1,173	5,034	0	5,034	2,122
2022	4,575	1,437	6,012	1,185	4,862	0	4,862	2,334
2023	4,601	1,454	6,055	1,196	4,691	0	4,691	2,561
2024	4,633	1,471	6,104	1,208	4,519	0	4,519	2,793
2025	4,663	1,488	6,150	1,220	4,347	0	4,347	3,023
2026	3,906	1,505	5,411	1,231	4,175	0	4,175	2,467
2027	3,355	1,522	4,877	1,243	4,004	0	4,004	2,117
2028	2,940	1,539	4,479	1,255	3,832	0	3,832	1,902
2029	2,526	1,556	4,081	1,267	3,660	0	3,660	1,688
2030	2,111	1,573	3,683	1,278	3,488	0	3,488	1,473
2031	2,094	1,587	3,681	1,290	3,364	0	3,364	1,606
2032	2,077	1,602	3,679	1,301	3,241	0	3,241	1,739
2033	2,060	1,617	3,677	1,312	3,117	0	3,117	1,873
2034	2,044	1,631	3,675	1,323	2,993	0	2,993	2,006
2035	2,015	1,646	3,661	1,334	2,869	0	2,869	2,126
2036	1,846	1,661	3,507	1,345	2,745	0	2,745	2,108
2037	1,828	1,676	3,503	1,357	2,621	0	2,621	2,239
2038	1,818	1,690	3,508	1,368	2,497	0	2,497	2,379
2039	1,809	1,705	3,513	1,379	2,373	0	2,373	2,519
2040	1,799	1,720	3,519	1,390	2,249	0	2,249	2,660

[16] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Statewide Water Conservation Quantification Project
City of San Marcos Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares San Marcos' current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) San Marcos' own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in San Marcos' most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for San Marcos with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	48	111	159	26	0	26	133
2016	86	115	200	32	0	32	168
2017	87	118	205	32	0	32	173
2018	88	122	210	39	0	39	171
2019	89	126	215	45	0	45	170
2020	90	130	220	58	0	58	162
2021	92	132	224	78	0	78	146
2022	93	135	228	97	0	97	130
2023	94	137	231	117	0	117	114
2024	95	140	235	136	0	136	99
2025	96	142	238	156	0	156	82
2026	97	145	242	175	0	175	66
2027	98	147	246	195	0	195	51
2028	100	150	250	215	0	215	35
2029	101	152	253	234	0	234	19
2030	102	155	257	254	0	254	4
2031	104	158	262	265	0	265	(3)
2032	106	161	266	276	0	276	(10)
2033	107	164	271	287	0	287	(16)
2034	109	167	276	298	0	298	(23)
2035	111	170	280	310	0	310	(29)
2036	112	173	285	321	0	321	(36)
2037	114	176	289	332	0	332	(43)
2038	115	179	294	343	0	343	(49)
2039	117	182	299	354	0	354	(56)
2040	119	185	303	366	0	366	(62)
2041	121	188	309	384	0	384	(75)
2042	123	192	314	402	0	402	(88)
2043	125	195	320	421	0	421	(101)
2044	127	199	325	439	0	439	(113)
2045	129	202	331	457	0	457	(126)
2046	131	206	337	476	0	476	(139)
2047	133	210	342	494	0	494	(152)
2048	135	213	348	512	0	512	(165)
2049	137	217	353	531	0	531	(177)
2050	139	220	359	549	0	549	(190)
2051	141	224	365	576	0	576	(210)
2052	143	229	372	602	0	602	(230)
2053	146	233	379	629	0	629	(251)
2054	148	237	385	656	0	656	(271)
2055	151	241	392	683	0	683	(291)
2056	153	246	399	710	0	710	(311)
2057	156	250	405	737	0	737	(331)
2058	158	254	412	763	0	763	(351)
2059	160	258	419	790	0	790	(371)
2060	163	263	425	817	0	817	(392)
2061	166	268	433	852	0	852	(419)
2062	169	273	441	887	0	887	(446)
2063	172	278	449	923	0	923	(473)
2064	174	283	457	958	0	958	(501)
2065	177	288	465	993	0	993	(528)
2066	180	293	473	1,028	0	1,028	(555)
2067	183	298	481	1,064	0	1,064	(583)
2068	186	303	489	1,099	0	1,099	(610)
2069	189	308	497	1,134	0	1,134	(637)
2070	192	313	505	1,169	0	1,169	(664)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how San Marcos' quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	122	0	0	0
1	2015	60,684	121	27	159	132
2	2016	62,771	120	55	200	145
3	2017	64,857	118	85	205	120
4	2018	66,944	117	117	210	93
5-year Goal	2019	69,030	116	151	215	64
6	2020	71,117	116	166	220	54
7	2021	72,487	115	180	224	44
8	2022	73,857	115	194	228	34
9	2023	75,227	114	209	231	23
10-year Goal	2024	76,597	114	224	235	11

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how San Marcos' most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	24	0	0	0
1	2,015	60,684	22	44	115	70
2	2,016	62,771	20	92	118	27
3	2,017	64,857	18	142	122	(20)
4	2,018	66,944	16	195	126	(69)
5-year Goal	2,019	69,030	14	252	130	(122)
6	2,020	71,117	14	260	132	(127)
7	2,021	72,487	14	265	135	(130)
8	2,022	73,857	14	270	137	(132)
9	2,023	75,227	14	275	140	(135)
10-year Goal	2,024	76,597	14	280	142	(137)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 111 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.0% increase in 2015
        ii. 5.0% increase in 2016
    b. Estimated customer demand reduction of 1.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. **Rain Barrels**
    a. 69,363 gallons of capacity rebated from 2010 – 2016
    b. In Region L, estimated savings of 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    c. Estimated 10-year useful life for most barrels

7. **Outdoor Landscape Evaluations (SF)**
    a. 64 outdoor evaluations performed since 2013
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

8. **High Efficiency (HE) Toilet Replacement Program (SF)**
    a. 249 toilets replaced from 2010 – 2016
        i. Only quantified for these years
    b. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
    c. Savings carry on indefinitely because replacement toilet will be as efficient

9. **HE Toilet Replacement (MF)**
    a. 371 toilets replaced from 2010 – 2016
    b. Estimated 15,756 gallons per year per toilet (A&N Technical Services, 2005)
    c. Savings carry on indefinitely because replacement toilet will be as efficient

10. **Tank-type HE Toilet Replacement (ICI)**
    a. 169 toilets replaced from 2010 – 2016
    b. Estimated 13,000 gallons per year per toilet (A&N Technical Services, 2005)
    c. Rebates per year provided by staff
    d. Savings carry on indefinitely because replacement toilet will be as efficient

11. **Clotheswasher Replacement Program (SF)**
    a. 125 rebates issued from 2010 – 2016
    b. Rebates per year provided by staff

c. Estimated 7,030 gallons per year per washer (A&N Technical Services, 2005; THELMA, 1997)
d. 11-year useful life
e. Savings carry on indefinitely because replacement washer will be as efficient due to plumbing code and efficiency standards

12. Additional Activities Not Quantified:

a. More stringent construction standards for new car washes, cooling systems, water features, dining facilities, laundry facilities, and irrigation systems

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	Rain Barrels	Tank-type HE Toilets (ICI)	Outdoor Landscape Evaluations (SF)	HE Toilets (SF)	HE Toilets (MF)	HE Clothes Washer Rebates (SF)	TOTAL SAVINGS
2009								0.0
2010		0.1	0.8		0.7	4.3	0.1	6.0
2011		0.2	0.8		1.2	4.3	0.3	6.7
2012		0.2	1.4		1.3	5.8	0.3	9.0
2013		0.5	1.4	0.1	1.5	5.8	0.5	9.8
2014		0.6	2.2	0.3	2.1	5.8	0.7	11.7
2015	36	1.1	2.2	0.2	2.4	5.8	0.9	48.3
2016	73	1.2	2.2	0.3	2.6	5.8	0.9	85.6
2017	74	1.2	2.2	0.2	2.6	5.8	0.9	86.8
2018	75	1.2	2.2	0.1	2.6	5.8	0.9	88.1
2019	76	1.2	2.2	0.1	2.6	5.8	0.9	89.3
2020	78	1.1	2.2	0.1	2.6	5.8	0.9	90.5
2021	79	1.0	2.2		2.6	5.8	0.9	91.7
2022	80	1.0	2.2		2.6	5.8	0.9	92.9
2023	82	0.8	2.2		2.6	5.8	0.9	94.0
2024	83	0.6	2.2		2.6	5.8	0.9	95.2
2025	84	0.1	2.2		2.6	5.8	0.9	96.0
2026	86		2.2		2.6	5.8	0.9	97.2
2027	87		2.2		2.6	5.8	0.9	98.5
2028	88		2.2		2.6	5.8	0.9	99.8
2029	90		2.2		2.6	5.8	0.9	101.1
2030	91		2.2		2.6	5.8	0.9	102.4
2031	93		2.2		2.6	5.8	0.9	104.0
2032	94		2.2		2.6	5.8	0.9	105.6
2033	96		2.2		2.6	5.8	0.9	107.3
2034	97		2.2		2.6	5.8	0.9	108.9
2035	99		2.2		2.6	5.8	0.9	110.5
2036	101		2.2		2.6	5.8	0.9	112.1
2037	102		2.2		2.6	5.8	0.9	113.8
2038	104		2.2		2.6	5.8	0.9	115.4
2039	105		2.2		2.6	5.8	0.9	117.0
2040	107		2.2		2.6	5.8	0.9	118.6
2041	109		2.2		2.6	5.8	0.9	120.6
2042	111		2.2		2.6	5.8	0.9	122.6
2043	113		2.2		2.6	5.8	0.9	124.6
2044	115		2.2		2.6	5.8	0.9	126.6
2045	117		2.2		2.6	5.8	0.9	128.6
2046	119		2.2		2.6	5.8	0.9	130.6
2047	121		2.2		2.6	5.8	0.9	132.6
2048	123		2.2		2.6	5.8	0.9	134.6
2049	125		2.2		2.6	5.8	0.9	136.6
2050	127		2.2		2.6	5.8	0.9	138.5
2051	129		2.2		2.6	5.8	0.9	141.0
2052	132		2.2		2.6	5.8	0.9	143.4
2053	134		2.2		2.6	5.8	0.9	145.8
2054	137		2.2		2.6	5.8	0.9	148.2
2055	139		2.2		2.6	5.8	0.9	150.7
2056	142		2.2		2.6	5.8	0.9	153.1
2057	144		2.2		2.6	5.8	0.9	155.5
2058	146		2.2		2.6	5.8	0.9	157.9
2059	149		2.2		2.6	5.8	0.9	160.4
2060	151		2.2		2.6	5.8	0.9	162.8
2061	154		2.2		2.6	5.8	0.9	165.7
2062	157		2.2		2.6	5.8	0.9	168.6
2063	160		2.2		2.6	5.8	0.9	171.5
2064	163		2.2		2.6	5.8	0.9	174.4
2065	166		2.2		2.6	5.8	0.9	177.3
2066	169		2.2		2.6	5.8	0.9	180.2
2067	172		2.2		2.6	5.8	0.9	183.1
2068	174		2.2		2.6	5.8	0.9	186.0
2069	177		2.2		2.6	5.8	0.9	188.9
2070	180		2.2		2.6	5.8	0.9	191.8

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	24.00	0
2015	60,684	19.00	111
2016	62,771	19.00	115
2017	64,857	19.00	118
2018	66,944	19.00	122
2019	69,030	19.00	126
2020	71,117	19.00	130
2021	72,487	19.00	132
2022	73,857	19.00	135
2023	75,227	19.00	137
2024	76,597	19.00	140

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.47% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 198 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	86	115	200	198	32	0	32	366
2017	87	118	205	202	32	0	32	375
2018	88	122	210	206	39	0	39	377
2019	89	126	215	209	45	0	45	379
2020	90	130	220	213	58	0	58	375
2021	92	132	224	216	78	0	78	362
2022	93	135	228	220	97	0	97	350
2023	94	137	231	224	117	0	117	338
2024	95	140	235	227	136	0	136	326
2025	96	142	238	231	156	0	156	313
2026	97	145	242	234	175	0	175	301
2027	98	147	246	238	195	0	195	289
2028	100	150	250	241	215	0	215	276
2029	101	152	253	245	234	0	234	264
2030	102	155	257	249	254	0	254	252
2031	104	158	262	253	265	0	265	250
2032	106	161	266	257	276	0	276	248
2033	107	164	271	262	287	0	287	246
2034	109	167	276	266	298	0	298	244
2035	111	170	280	271	310	0	310	241
2036	112	173	285	275	321	0	321	239
2037	114	176	289	280	332	0	332	237
2038	115	179	294	284	343	0	343	235
2039	117	182	299	289	354	0	354	233
2040	119	185	303	293	366	0	366	231

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI from Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	86	115	200	49	32	0	32	216
2017	87	118	205	49	32	0	32	222
2018	88	122	210	50	39	0	39	222
2019	89	126	215	51	45	0	45	221
2020	90	130	220	52	58	0	58	214
2021	92	132	224	53	78	0	78	199
2022	93	135	228	54	97	0	97	184
2023	94	137	231	55	117	0	117	169
2024	95	140	235	56	136	0	136	154
2025	96	142	238	57	156	0	156	139
2026	97	145	242	57	175	0	175	124
2027	98	147	246	58	195	0	195	109
2028	100	150	250	59	215	0	215	94
2029	101	152	253	60	234	0	234	79
2030	102	155	257	61	254	0	254	65
2031	104	158	262	62	265	0	265	59
2032	106	161	266	63	276	0	276	53
2033	107	164	271	64	287	0	287	48
2034	109	167	276	65	298	0	298	42
2035	111	170	280	66	310	0	310	37
2036	112	173	285	67	321	0	321	31
2037	114	176	289	69	332	0	332	26
2038	115	179	294	70	343	0	343	20
2039	117	182	299	71	354	0	354	15
2040	119	185	303	72	366	0	366	9

Statewide Water Conservation Quantification Project
Universal City Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Universal City's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Universal City's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Universal City's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Universal City with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	20.5	44	64	0	0	0	64
2016	28.9	44	73	0	0	0	73
2017	29.0	45	74	0	0	0	74
2018	29.0	46	75	0	0	0	75
2019	29.0	46	75	0	0	0	75
2020	29.0	47	76	0	0	0	76
2021	29.0	47	76	0	0	0	76
2022	29.0	47	76	0	0	0	76
2023	29.0	47	76	0	0	0	76
2024	29.0	47	76	0	0	0	76
2025	29.1	47	76	0	0	0	76
2026	29.1	48	77	0	0	0	77
2027	29.1	48	77	0	0	0	77
2028	29.1	48	77	0	0	0	77
2029	29.1	48	77	0	0	0	77
2030	29.1	48	77	0	0	0	77
2031	29.1	48	77	0	0	0	77
2032	29.0	48	77	0	0	0	77
2033	29.0	48	77	0	0	0	77
2034	28.9	48	77	0	0	0	77
2035	28.9	48	77	0	0	0	77
2036	28.8	48	77	0	0	0	77
2037	28.8	48	77	0	0	0	77
2038	28.7	48	77	0	0	0	77
2039	28.7	48	77	0	0	0	77
2040	28.6	48	77	0	0	0	77
2041	28.6	48	77	0	0	0	77
2042	28.6	48	77	0	0	0	77
2043	28.5	48	77	0	0	0	77
2044	28.5	48	77	0	0	0	77
2045	28.5	48	77	0	0	0	77
2046	28.5	48	77	0	0	0	77
2047	28.4	48	77	0	0	0	77
2048	28.4	48	77	0	0	0	77
2049	28.4	48	76	0	0	0	76
2050	28.3	48	76	0	0	0	76
2051	28.3	48	76	2	0	2	74
2052	28.3	48	76	4	0	4	72
2053	28.3	48	76	7	0	7	70
2054	28.3	48	76	9	0	9	67
2055	28.3	48	76	11	0	11	65
2056	28.3	48	76	13	0	13	63
2057	28.3	48	76	16	0	16	61
2058	28.3	48	76	18	0	18	58
2059	28.3	48	76	20	0	20	56
2060	28.3	48	76	22	0	22	54
2061	28.3	48	76	25	0	25	52
2062	28.3	48	76	27	0	27	49
2063	28.3	48	76	30	0	30	47
2064	28.3	48	76	32	0	32	44
2065	28.3	48	76	35	0	35	42
2066	28.3	48	76	37	0	37	39
2067	28.3	48	76	39	0	39	37
2068	28.3	48	76	42	0	42	35
2069	28.3	48	76	44	0	44	32
2070	28.3	48	76	47	0	47	30

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Universal City's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	136	0	0	0
1	2015	19,986	135	10	64	54
2	2016	20,255	133	21	73	53
3	2017	20,524	132	31	74	42
4	2018	20,794	130	43	75	32
5-year Goal	2019	21,063	129	54	75	21
6	2020	21,332	128	64	76	12
7	2021	21,396	127	73	76	2
8	2022	21,460	125	83	76	-7
9	2023	21,523	124	93	76	-17
10-year Goal	2024	21,587	123	102	76	-26

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Universal City's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	9.00	0	0	0
1	2015	19,986	8.80	1	44	42
2	2016	20,255	8.60	3	44	41
3	2017	20,524	8.40	4	45	40
4	2018	20,794	8.20	6	46	39
5-year Goal	2019	21,063	8.00	8	46	38
6	2020	21,332	7.80	9	47	37
7	2021	21,396	7.60	11	47	36
8	2022	21,460	7.40	13	47	34
9	2023	21,523	7.20	14	47	33
10-year Goal	2024	21,587	7.00	16	47	32

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 44 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 9.0% increase in 2015
        ii. 5.0% increase in 2016
    b. Estimated customer demand reduction of 2.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. High Efficiency (HE) Toilet Replacement Program (SF)
   a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
   b. Savings carry on indefinitely because replacement toilet will be as efficient

7. Clotheswasher Replacement Program (SF)
   a. Estimated 83 rebates issued from 2011 – 2016
   b. Rebates per year provided by staff
   c. Estimated 7,030 gallons per year per washer (A&N Technical Services, 2005; THELMA, 1997)
   d. 11-year useful life

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Clothes Washer Rebate (SF)	HE Toilet Rebate (SF)	Water Rate Increases	TOTAL SAVINGS
2009				0
2010		0.2		0.2
2011	0.1	0.5		0.7
2012	0.3	0.9		1.2
2013	0.4	1.1		1.5
2014	0.4	1.2		1.7
2015	0.5	1.4	19	20.5
2016	0.5	1.4	27	28.9
2017	0.5	1.4	27	29.0
2018	0.5	1.4	27	29.0
2019	0.5	1.4	27	29.0
2020	0.5	1.4	27	29.0
2021	0.5	1.4	27	29.0
2022	0.5	1.4	27	29.0
2023	0.5	1.4	27	29.0
2024	0.5	1.4	27	29.0
2025	0.5	1.4	27	29.1
2026	0.5	1.4	27	29.1
2027	0.5	1.4	27	29.1
2028	0.5	1.4	27	29.1
2029	0.5	1.4	27	29.1
2030	0.5	1.4	27	29.1
2031	0.5	1.4	27	29.1
2032	0.5	1.4	27	29.0
2033	0.5	1.4	27	29.0
2034	0.5	1.4	27	28.9
2035	0.5	1.4	27	28.9
2036	0.5	1.4	27	28.8
2037	0.5	1.4	27	28.8
2038	0.5	1.4	27	28.7
2039	0.5	1.4	27	28.7
2040	0.5	1.4	27	28.6
2041	0.5	1.4	27	28.6
2042	0.5	1.4	27	28.6
2043	0.5	1.4	27	28.5
2044	0.5	1.4	27	28.5
2045	0.5	1.4	27	28.5
2046	0.5	1.4	27	28.5
2047	0.5	1.4	27	28.4
2048	0.5	1.4	26	28.4
2049	0.5	1.4	26	28.4
2050	0.5	1.4	26	28.3
2051	0.5	1.4	26	28.3
2052	0.5	1.4	26	28.3
2053	0.5	1.4	26	28.3
2054	0.5	1.4	26	28.3
2055	0.5	1.4	26	28.3
2056	0.5	1.4	26	28.3
2057	0.5	1.4	26	28.3
2058	0.5	1.4	26	28.3
2059	0.5	1.4	26	28.3
2060	0.5	1.4	26	28.3
2061	0.5	1.4	26	28.3
2062	0.5	1.4	26	28.3
2063	0.5	1.4	26	28.3
2064	0.5	1.4	26	28.3
2065	0.5	1.4	26	28.3
2066	0.5	1.4	26	28.3
2067	0.5	1.4	26	28.3
2068	0.5	1.4	26	28.3
2069	0.5	1.4	26	28.3
2070	0.5	1.4	26	28.3

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	9.00	0
2015	19,986	3.00	44
2016	20,255	3.00	44
2017	20,524	3.00	45
2018	20,794	3.00	46
2019	21,063	3.00	46
2020	21,332	3.00	47
2021	21,396	3.00	47
2022	21,460	3.00	47
2023	21,523	3.00	47
2024	21,587	3.00	47

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.89% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    b. Savings could be 61 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	29	44	73	61	0	0	0	135
2017	29	45	74	61	0	0	0	135
2018	29	46	75	61	0	0	0	136
2019	29	46	75	61	0	0	0	136
2020	29	47	76	61	0	0	0	137
2021	29	47	76	61	0	0	0	137
2022	29	47	76	61	0	0	0	137
2023	29	47	76	61	0	0	0	138
2024	29	47	76	61	0	0	0	138
2025	29	47	76	61	0	0	0	138
2026	29	48	77	62	0	0	0	138
2027	29	48	77	62	0	0	0	138
2028	29	48	77	62	0	0	0	138
2029	29	48	77	62	0	0	0	139
2030	29	48	77	62	0	0	0	139
2031	29	48	77	62	0	0	0	139
2032	29	48	77	61	0	0	0	139
2033	29	48	77	61	0	0	0	138
2034	29	48	77	61	0	0	0	138
2035	29	48	77	61	0	0	0	138
2036	29	48	77	61	0	0	0	138
2037	29	48	77	61	0	0	0	138
2038	29	48	77	61	0	0	0	138
2039	29	48	77	61	0	0	0	137
2040	29	48	77	60	0	0	0	137

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	29	44	73	14	0	0	0	87
2017	29	45	74	14	0	0	0	88
2018	29	46	75	14	0	0	0	88
2019	29	46	75	14	0	0	0	89
2020	29	47	76	14	0	0	0	90
2021	29	47	76	14	0	0	0	90
2022	29	47	76	14	0	0	0	90
2023	29	47	76	14	0	0	0	90
2024	29	47	76	14	0	0	0	90
2025	29	47	76	14	0	0	0	90
2026	29	48	77	14	0	0	0	91
2027	29	48	77	14	0	0	0	91
2028	29	48	77	14	0	0	0	91
2029	29	48	77	14	0	0	0	91
2030	29	48	77	14	0	0	0	91
2031	29	48	77	14	0	0	0	91
2032	29	48	77	14	0	0	0	91
2033	29	48	77	14	0	0	0	91
2034	29	48	77	14	0	0	0	91
2035	29	48	77	14	0	0	0	91
2036	29	48	77	14	0	0	0	91
2037	29	48	77	14	0	0	0	91
2038	29	48	77	14	0	0	0	91
2039	29	48	77	14	0	0	0	91
2040	29	48	77	14	0	0	0	91

3. Rain Barrels
   a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Uvalde Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Uvalde's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Uvalde's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Uvalde's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility’s baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Uvalde with the utility’s yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB.[12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4	(169)	(165)	26	0	26	(191)
2016	7	(170)	(163)	32	0	32	(195)
2017	7	(172)	(164)	32	0	32	(197)
2018	7	(173)	(166)	39	0	39	(204)
2019	6	(174)	(168)	45	0	45	(213)
2020	5	(176)	(171)	58	0	58	(229)
2021	5	(178)	(172)	69	0	69	(241)
2022	5	(179)	(174)	80	0	80	(254)
2023	5	(181)	(176)	91	0	91	(266)
2024	5	(182)	(177)	101	0	101	(279)
2025	5	(184)	(179)	112	0	112	(291)
2026	5	(186)	(181)	123	0	123	(304)
2027	5	(187)	(182)	134	0	134	(316)
2028	5	(189)	(184)	145	0	145	(329)
2029	5	(191)	(186)	156	0	156	(341)
2030	5	(192)	(187)	167	0	167	(354)
2031	5	(194)	(189)	178	0	178	(367)
2032	5	(195)	(190)	190	0	190	(380)
2033	5	(197)	(192)	202	0	202	(394)
2034	5	(198)	(193)	214	0	214	(407)
2035	5	(199)	(194)	226	0	226	(420)
2036	5	(201)	(196)	238	0	238	(433)
2037	5	(202)	(197)	249	0	249	(447)
2038	5	(204)	(199)	261	0	261	(460)
2039	5	(205)	(200)	273	0	273	(473)
2040	5	(206)	(201)	285	0	285	(486)
2041	5	(208)	(203)	298	0	298	(501)
2042	5	(209)	(204)	311	0	311	(516)
2043	5	(211)	(206)	324	0	324	(530)
2044	5	(212)	(207)	338	0	338	(545)
2045	5	(214)	(209)	351	0	351	(560)
2046	5	(215)	(210)	364	0	364	(574)
2047	5	(217)	(212)	377	0	377	(589)
2048	5	(218)	(213)	390	0	390	(604)
2049	5	(220)	(215)	404	0	404	(618)
2050	5	(221)	(216)	417	0	417	(633)
2051	5	(222)	(217)	428	0	428	(645)
2052	5	(224)	(219)	439	0	439	(657)
2053	5	(225)	(220)	449	0	449	(670)
2054	5	(227)	(222)	460	0	460	(682)
2055	5	(228)	(223)	471	0	471	(694)
2056	5	(229)	(224)	482	0	482	(706)
2057	5	(231)	(226)	493	0	493	(719)
2058	5	(232)	(227)	504	0	504	(731)
2059	5	(234)	(229)	514	0	514	(743)
2060	5	(235)	(230)	525	0	525	(755)
2061	5	(236)	(231)	531	0	531	(763)
2062	5	(238)	(233)	537	0	537	(770)
2063	5	(239)	(234)	543	0	543	(777)
2064	5	(240)	(235)	549	0	549	(785)
2065	5	(242)	(237)	555	0	555	(792)
2066	5	(243)	(238)	561	0	561	(799)
2067	5	(244)	(239)	567	0	567	(807)
2068	5	(246)	(241)	573	0	573	(814)
2069	5	(247)	(242)	579	0	579	(821)
2070	5	(248)	(243)	585	0	585	(829)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Uvalde's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	236	0	0	0
1	2008	15,492	234	14	0	(14)
2	2009	15,637	231	27	0	(27)
3	2010	15,782	229	41	0	(41)
4	2011	15,927	226	56	0	(56)
5-year Goal	2012	16,072	224	70	0	(70)
6	2013	16,217	222	85	0	(85)
7	2014	16,362	219	100	2	(98)
8	2015	16,507	217	116	(165)	(281)
9	2016	16,647	214	131	(163)	(294)
10-year Goal	2017	16,787	212	147	(164)	(311)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Uvalde's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2008	15,492	15.80	7	0	(7)
2	2009	15,637	14.60	14	0	(14)
3	2010	15,782	13.40	21	0	(21)
4	2011	15,927	12.20	28	0	(28)
5-year Goal	2012	16,072	11.00	35	0	(35)
6	2013	16,217	10.00	41	0	(41)
7	2014	16,362	9.00	48	0	(48)
8	2015	16,507	8.00	54	(169)	(223)
9	2016	16,647	7.00	61	(170)	(231)
10-year Goal	2017	16,787	6.00	67	(172)	(239)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 169 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **WaterWise Take-home Kits**
    a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
    b. Conservative 5-year useful life for all items in kit
    c. 15% adoption rate assumed

5. **Showerhead Distribution (SF)**
    a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
    b. 5-year useful life
        i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	WaterWise Take-home Kits	Low-flow Showerheads (Residential)	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014	1.1	1.4	2.5
2015	2.2	1.4	3.6
2016	2.2	5.0	7.3
2017	2.2	5.0	7.3
2018	2.2	5.0	7.3
2019	1.1	5.0	6.2
2020		5.0	5
2021		5.0	5
2022		5.0	5
2023		5.0	5
2024		5.0	5
2025		5.0	5
2026		5.0	5
2027		5.0	5
2028		5.0	5
2029		5.0	5
2030		5.0	5
2031		5.0	5
2032		5.0	5
2033		5.0	5
2034		5.0	5
2035		5.0	5
2036		5.0	5
2037		5.0	5
2038		5.0	5
2039		5.0	5
2040		5.0	5
2041		5.0	5
2042		5.0	5
2043		5.0	5
2044		5.0	5
2045		5.0	5
2046		5.0	5
2047		5.0	5
2048		5.0	5
2049		5.0	5
2050		5.0	5
2051		5.0	5
2052		5.0	5
2053		5.0	5
2054		5.0	5
2055		5.0	5
2056		5.0	5
2057		5.0	5
2058		5.0	5
2059		5.0	5
2060		5.0	5
2061		5.0	5
2062		5.0	5
2063		5.0	5
2064		5.0	5
2065		5.0	5
2066		5.0	5
2067		5.0	5
2068		5.0	5
2069		5.0	5
2070		5.0	5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	16,507	45.00	(169)
2016	16,647	45.00	(170)
2017	16,787	45.00	(172)
2018	16,928	45.00	(173)
2019	17,068	45.00	(174)
2020	17,208	45.00	(176)
2021	17,369	45.00	(178)
2022	17,530	45.00	(179)
2023	17,691	45.00	(181)
2024	17,852	45.00	(182)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 7.79% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 100 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	(170)	(163)	100	32	0	32	(95)
2017	7	(172)	(164)	101	32	0	32	(96)
2018	7	(173)	(166)	101	39	0	39	(103)
2019	6	(174)	(168)	102	45	0	45	(111)
2020	5	(176)	(171)	103	58	0	58	(126)
2021	5	(178)	(172)	104	69	0	69	(138)
2022	5	(179)	(174)	104	80	0	80	(149)
2023	5	(181)	(176)	105	91	0	91	(161)
2024	5	(182)	(177)	106	101	0	101	(173)
2025	5	(184)	(179)	107	112	0	112	(185)
2026	5	(186)	(181)	107	123	0	123	(197)
2027	5	(187)	(182)	108	134	0	134	(208)
2028	5	(189)	(184)	109	145	0	145	(220)
2029	5	(191)	(186)	109	156	0	156	(232)
2030	5	(192)	(187)	110	167	0	167	(244)
2031	5	(194)	(189)	111	178	0	178	(256)
2032	5	(195)	(190)	112	190	0	190	(269)
2033	5	(197)	(192)	112	202	0	202	(281)
2034	5	(198)	(193)	113	214	0	214	(294)
2035	5	(199)	(194)	113	226	0	226	(307)
2036	5	(201)	(196)	114	238	0	238	(319)
2037	5	(202)	(197)	115	249	0	249	(332)
2038	5	(204)	(199)	115	261	0	261	(344)
2039	5	(205)	(200)	116	273	0	273	(357)
2040	5	(206)	(201)	117	285	0	285	(370)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	(170)	(163)	17	32	0	32	(178)
2017	7	(172)	(164)	17	32	0	32	(179)
2018	7	(173)	(166)	17	39	0	39	(187)
2019	6	(174)	(168)	18	45	0	45	(196)
2020	5	(176)	(171)	18	58	0	58	(211)
2021	5	(178)	(172)	18	69	0	69	(224)
2022	5	(179)	(174)	18	80	0	80	(236)
2023	5	(181)	(176)	18	91	0	91	(248)
2024	5	(182)	(177)	18	101	0	101	(261)
2025	5	(184)	(179)	18	112	0	112	(273)
2026	5	(186)	(181)	18	123	0	123	(285)
2027	5	(187)	(182)	19	134	0	134	(298)
2028	5	(189)	(184)	19	145	0	145	(310)
2029	5	(191)	(186)	19	156	0	156	(322)
2030	5	(192)	(187)	19	167	0	167	(335)
2031	5	(194)	(189)	19	178	0	178	(348)
2032	5	(195)	(190)	19	190	0	190	(361)
2033	5	(197)	(192)	19	202	0	202	(374)
2034	5	(198)	(193)	19	214	0	214	(387)
2035	5	(199)	(194)	20	226	0	226	(401)
2036	5	(201)	(196)	20	238	0	238	(414)
2037	5	(202)	(197)	20	249	0	249	(427)
2038	5	(204)	(199)	20	261	0	261	(440)
2039	5	(205)	(200)	20	273	0	273	(453)
2040	5	(206)	(201)	20	285	0	285	(466)

3. Water Rate Increase
    - **a.** For every 10% increase, estimated savings could be 2% of utility total demand.
    - **b.** Approximately 26 MG of savings per year with current demand
    - **c.** Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    - **d.** See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	7	(170)	(163)	26	32	0	32	(169)
2017	7	(172)	(164)	26	32	0	32	(171)
2018	7	(173)	(166)	26	39	0	39	(178)
2019	6	(174)	(168)	26	45	0	45	(187)
2020	5	(176)	(171)	26	58	0	58	(202)
2021	5	(178)	(172)	27	69	0	69	(215)
2022	5	(179)	(174)	27	80	0	80	(227)
2023	5	(181)	(176)	27	91	0	91	(239)
2024	5	(182)	(177)	27	101	0	101	(252)
2025	5	(184)	(179)	27	112	0	112	(264)
2026	5	(186)	(181)	28	123	0	123	(276)
2027	5	(187)	(182)	28	134	0	134	(289)
2028	5	(189)	(184)	28	145	0	145	(301)
2029	5	(191)	(186)	28	156	0	156	(313)
2030	5	(192)	(187)	28	167	0	167	(326)
2031	5	(194)	(189)	28	178	0	178	(339)
2032	5	(195)	(190)	29	190	0	190	(352)
2033	5	(197)	(192)	29	202	0	202	(365)
2034	5	(198)	(193)	29	214	0	214	(378)
2035	5	(199)	(194)	29	226	0	226	(391)
2036	5	(201)	(196)	29	238	0	238	(404)
2037	5	(202)	(197)	29	249	0	249	(417)
2038	5	(204)	(199)	30	261	0	261	(430)
2039	5	(205)	(200)	30	273	0	273	(443)
2040	5	(206)	(201)	30	285	0	285	(456)

4. Rain Barrels
    a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Victoria Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only “advanced conservation” activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility’s conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity’s implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities’ savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Victoria's current water conservation activities and their quantified savings to two metrics: 1) Region L Water Plan's (Texas Water Development Board, 2016j) recommended WMS supply volumes for municipal conservation, and 2) Victoria's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Victoria's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Victoria with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	76	419	495	117	0	117	378
2016	77	420	496	146	0	146	350
2017	77	420	497	146	0	146	350
2018	77	420	497	176	0	176	322
2019	78	420	498	205	0	205	293
2020	78	421	499	264	0	264	235
2021	78	424	502	309	0	309	193
2022	79	426	505	354	0	354	151
2023	79	429	509	400	0	400	109
2024	80	432	512	445	0	445	67
2025	80	435	515	490	0	490	25
2026	80	438	519	536	0	536	(17)
2027	81	441	522	581	0	581	(59)
2028	81	444	525	626	0	626	(101)
2029	82	447	528	672	0	672	(143)
2030	82	450	532	717	0	717	(185)
2031	82	452	534	764	0	764	(230)
2032	83	454	537	811	0	811	(274)
2033	83	457	540	858	0	858	(318)
2034	83	459	542	905	0	905	(363)
2035	83	461	545	952	0	952	(407)
2036	84	464	547	999	0	999	(452)
2037	84	466	550	1,046	0	1,046	(496)
2038	84	468	553	1,093	0	1,093	(540)
2039	85	471	555	1,140	0	1,140	(585)
2040	85	473	558	1,187	0	1,187	(629)
2041	85	475	560	1,236	0	1,236	(676)
2042	86	477	563	1,286	0	1,286	(723)
2043	86	479	565	1,335	0	1,335	(770)
2044	86	481	567	1,385	0	1,385	(817)
2045	87	483	570	1,434	0	1,434	(864)
2046	87	485	572	1,483	0	1,483	(911)
2047	87	487	574	1,533	0	1,533	(958)
2048	87	489	577	1,582	0	1,582	(1,006)
2049	88	491	579	1,632	0	1,632	(1,053)
2050	88	493	581	1,681	0	1,681	(1,100)
2051	88	495	583	1,731	0	1,731	(1,148)
2052	89	497	585	1,782	0	1,782	(1,197)
2053	89	498	587	1,832	0	1,832	(1,245)
2054	89	500	589	1,883	0	1,883	(1,293)
2055	89	502	591	1,933	0	1,933	(1,342)
2056	90	503	593	1,983	0	1,983	(1,390)
2057	90	505	595	2,034	0	2,034	(1,439)
2058	90	507	597	2,084	0	2,084	(1,487)
2059	91	508	599	2,135	0	2,135	(1,536)
2060	91	510	601	2,185	0	2,185	(1,584)
2061	91	512	603	2,212	0	2,212	(1,609)
2062	91	513	604	2,238	0	2,238	(1,634)
2063	92	514	606	2,265	0	2,265	(1,659)
2064	92	516	608	2,291	0	2,291	(1,683)
2065	92	517	609	2,317	0	2,317	(1,708)
2066	92	518	611	2,344	0	2,344	(1,733)
2067	93	520	613	2,370	0	2,370	(1,758)
2068	93	521	614	2,397	0	2,397	(1,783)
2069	93	523	616	2,423	0	2,423	(1,808)
2070	93	524	617	2,450	0	2,450	(1,832)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Victoria's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	153	0	0	0
1	2015	67,574	151	44	495	451
2	2016	67,617	149	89	496	407
3	2017	67,659	148	133	497	363
4	2018	67,702	146	178	497	319
5-year Goal	2019	67,744	144	223	498	275
6	2020	67,787	144	233	499	266
7	2021	68,258	143	244	502	258
8	2022	68,729	143	256	505	249
9	2023	69,200	142	268	509	241
10-year Goal	2024	69,671	142	280	512	232

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Victoria's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	153	0	0	0
1	2015	67,574	151	44	495	451
2	2016	67,617	149	89	496	407
3	2017	67,659	148	133	497	363
4	2018	67,702	146	178	497	319
5-year Goal	2019	67,744	144	223	498	275
6	2020	67,787	144	233	499	266
7	2021	68,258	143	244	502	258
8	2022	68,729	143	256	505	249
9	2023	69,200	142	268	509	241
10-year Goal	2024	69,671	142	280	512	232

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**
    a. Loss of 419 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[16]
        i. 7.0% increase in 2014
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
    c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.

---

[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	75.7	76
2015	76.1	76
2016	76.5	77
2017	76.9	77
2018	77.3	77
2019	77.7	78
2020	78.1	78
2021	78.5	78
2022	78.8	79
2023	79.2	79
2024	79.6	80
2025	80.0	80
2026	80.4	80
2027	80.8	81
2028	81.2	81
2029	81.6	82
2030	82.0	82
2031	82.3	82
2032	82.6	83
2033	82.9	83
2034	83.2	83
2035	83.5	83
2036	83.8	84
2037	84.1	84
2038	84.4	84
2039	84.7	85
2040	85.0	85
2041	85.3	85
2042	85.6	86
2043	85.9	86
2044	86.2	86
2045	86.5	87
2046	86.8	87
2047	87.1	87
2048	87.4	87
2049	87.7	88
2050	88.1	88
2051	88.3	88
2052	88.6	89
2053	88.9	89
2054	89.2	89
2055	89.5	89
2056	89.8	90
2057	90.1	90
2058	90.4	90
2059	90.6	91
2060	90.9	91
2061	91.2	91
2062	91.4	91
2063	91.7	92
2064	91.9	92
2065	92.2	92
2066	92.4	92
2067	92.7	93
2068	92.9	93
2069	93.2	93
2070	93.4	93

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	31.00	0
2015	67,574	14.00	419
2016	67,617	14.00	420
2017	67,659	14.00	420
2018	67,702	14.00	420
2019	67,744	14.00	420
2020	67,787	14.00	421
2021	68,258	14.00	424
2022	68,729	14.00	426
2023	69,200	14.00	429
2024	69,671	14.00	432

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.26% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 287 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	77	420	496	287	146	0	146	637
2017	77	420	497	289	146	0	146	639
2018	77	420	497	290	176	0	176	612
2019	78	420	498	292	205	0	205	585
2020	78	421	499	293	264	0	264	528
2021	78	424	502	295	309	0	309	488
2022	79	426	505	296	354	0	354	447
2023	79	429	509	298	400	0	400	407
2024	80	432	512	299	445	0	445	366
2025	80	435	515	301	490	0	490	326
2026	80	438	519	302	536	0	536	285
2027	81	441	522	304	581	0	581	244
2028	81	444	525	305	626	0	626	204
2029	82	447	528	307	672	0	672	163
2030	82	450	532	308	717	0	717	123
2031	82	452	534	309	764	0	764	80
2032	83	454	537	310	811	0	811	36
2033	83	457	540	311	858	0	858	(7)
2034	83	459	542	313	905	0	905	(50)
2035	83	461	545	314	952	0	952	(93)
2036	84	464	547	315	999	0	999	(137)
2037	84	466	550	316	1,046	0	1,046	(180)
2038	84	468	553	317	1,093	0	1,093	(223)
2039	85	471	555	318	1,140	0	1,140	(267)
2040	85	473	558	319	1,187	0	1,187	(310)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	77	420	496	73	146	0	146	423
2017	77	420	497	74	146	0	146	424
2018	77	420	497	74	176	0	176	396
2019	78	420	498	74	205	0	205	367
2020	78	421	499	75	264	0	264	310
2021	78	424	502	75	309	0	309	268
2022	79	426	505	75	354	0	354	226
2023	79	429	509	76	400	0	400	185
2024	80	432	512	76	445	0	445	143
2025	80	435	515	77	490	0	490	102
2026	80	438	519	77	536	0	536	60
2027	81	441	522	77	581	0	581	18
2028	81	444	525	78	626	0	626	(23)
2029	82	447	528	78	672	0	672	(65)
2030	82	450	532	78	717	0	717	(107)
2031	82	452	534	79	764	0	764	(151)
2032	83	454	537	79	811	0	811	(195)
2033	83	457	540	79	858	0	858	(239)
2034	83	459	542	80	905	0	905	(283)
2035	83	461	545	80	952	0	952	(327)
2036	84	464	547	80	999	0	999	(371)
2037	84	466	550	80	1,046	0	1,046	(415)
2038	84	468	553	81	1,093	0	1,093	(460)
2039	85	471	555	81	1,140	0	1,140	(504)
2040	85	473	558	81	1,187	0	1,187	(548)

3. Rain Barrels
   a. In Region L, utilities could save approximately 17 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Region M Individual Reports

Statewide Water Conservation Quantification Project
Agua SUD Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Agua SUD's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Agua SUD's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Agua SUD's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8,9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

5 Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

6 Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

7 As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

8 These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

9 As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Agua SUD with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	26	50	76	0	0	0	76
2016	27	51	78	0	0	0	78
2017	28	53	80	0	0	0	80
2018	28	54	82	0	0	0	82
2019	29	56	84	0	0	0	84
2020	29	57	86	0	0	0	86
2021	30	58	88	0	0	0	88
2022	31	60	90	0	0	0	90
2023	31	61	92	0	0	0	92
2024	32	63	94	0	0	0	94
2025	32	64	96	0	0	0	96
2026	33	65	98	0	0	0	98
2027	34	67	100	0	0	0	100
2028	34	68	102	0	0	0	102
2029	35	69	104	0	0	0	104
2030	35	71	106	0	0	0	106
2031	36	72	108	4	0	4	104
2032	37	74	110	9	0	9	102
2033	37	75	112	13	0	13	99
2034	38	76	114	17	0	17	97
2035	38	78	116	21	0	21	95
2036	39	79	118	26	0	26	93
2037	40	81	120	30	0	30	90
2038	40	82	122	34	0	34	88
2039	41	83	124	38	0	38	86
2040	42	85	126	43	0	43	84
2041	42	86	128	56	0	56	73
2042	43	88	130	69	0	69	62
2043	43	89	132	81	0	81	51
2044	44	90	134	94	0	94	40
2045	45	92	136	107	0	107	29
2046	45	93	138	120	0	120	18
2047	46	94	140	133	0	133	7
2048	47	96	142	146	0	146	(3)
2049	47	97	145	159	0	159	(14)
2050	48	99	147	172	0	172	(25)
2051	49	100	149	189	0	189	(40)
2052	49	101	151	206	0	206	(56)
2053	50	103	153	224	0	224	(71)
2054	51	104	155	241	0	241	(86)
2055	51	106	157	258	0	258	(101)
2056	52	107	159	276	0	276	(117)
2057	53	108	161	293	0	293	(132)
2058	53	110	163	310	0	310	(147)
2059	54	111	165	327	0	327	(163)
2060	55	112	167	345	0	345	(178)
2061	55	114	169	365	0	365	(196)
2062	56	115	171	386	0	386	(215)
2063	56	117	173	406	0	406	(233)
2064	57	118	175	427	0	427	(252)
2065	58	119	177	447	0	447	(270)
2066	58	121	179	468	0	468	(289)
2067	59	122	181	489	0	489	(308)
2068	60	123	183	509	0	509	(326)
2069	60	125	185	530	0	530	(345)
2070	61	126	187	550	0	550	(363)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Agua SUD's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	103	0	0	0
1	2015	45,483	101	27	76	50
2	2016	46,812	100	55	78	24
3	2017	48,141	98	84	80	(4)
4	2018	49,471	97	116	82	(33)
5-year Goal	2019	50,800	95	148	84	(64)
6	2020	52,129	94	171	86	(85)
7	2021	53,389	93	195	88	(106)
8	2022	54,649	92	219	90	(129)
9	2023	55,909	91	245	92	(153)
10-year Goal	2024	57,169	90	271	94	(177)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Agua SUD's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	45,483	14.60	7	50	43
2	2016	46,812	14.20	14	51	38
3	2017	48,141	13.80	21	53	32
4	2018	49,471	13.40	29	54	25
5-year Goal	2019	50,800	13.00	37	56	19
6	2020	52,129	12.90	40	57	17
7	2021	53,389	12.80	43	58	16
8	2022	54,649	12.70	46	60	14
9	2023	55,909	12.60	49	61	12
10-year Goal	2024	57,169	12.50	52	63	10

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 50 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 8.0% increase in 2014
    b. Estimated customer demand reduction of 1.6%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	26	26
2015	26	26
2016	27	27
2017	28	28
2018	28	28
2019	29	29
2020	29	29
2021	30	30
2022	31	31
2023	31	31
2024	32	32
2025	32	32
2026	33	33
2027	34	34
2028	34	34
2029	35	35
2030	35	35
2031	36	36
2032	37	37
2033	37	37
2034	38	38
2035	38	38
2036	39	39
2037	40	40
2038	40	40
2039	41	41
2040	42	42
2041	42	42
2042	43	43
2043	43	43
2044	44	44
2045	45	45
2046	45	45
2047	46	46
2048	47	47
2049	47	47
2050	48	48
2051	49	49
2052	49	49
2053	50	50
2054	51	51
2055	51	51
2056	52	52
2057	53	53
2058	53	53
2059	54	54
2060	55	55
2061	55	55
2062	56	56
2063	56	56
2064	57	57
2065	58	58
2066	58	58
2067	59	59
2068	60	60
2069	60	60
2070	61	61

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	15.00	0
2015	45,483	12.00	50
2016	46,812	12.00	51
2017	48,141	12.00	53
2018	49,471	12.00	54
2019	50,800	12.00	56
2020	52,129	12.00	57
2021	53,389	12.00	58
2022	54,649	12.00	60
2023	55,909	12.00	61
2024	57,169	12.00	63

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 85 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	27	51	78	85	0	0	0	163
2017	28	53	80	87	0	0	0	167
2018	28	54	82	89	0	0	0	171
2019	29	56	84	91	0	0	0	175
2020	29	57	86	93	0	0	0	179
2021	30	58	88	94	0	0	0	183
2022	31	60	90	96	0	0	0	187
2023	31	61	92	98	0	0	0	191
2024	32	63	94	100	0	0	0	194
2025	32	64	96	102	0	0	0	198
2026	33	65	98	104	0	0	0	202
2027	34	67	100	106	0	0	0	206
2028	34	68	102	108	0	0	0	210
2029	35	69	104	110	0	0	0	214
2030	35	71	106	111	0	0	0	218
2031	36	72	108	113	4	0	4	217
2032	37	74	110	115	9	0	9	217
2033	37	75	112	117	13	0	13	217
2034	38	76	114	119	17	0	17	216
2035	38	78	116	121	21	0	21	216
2036	39	79	118	123	26	0	26	216
2037	40	81	120	125	30	0	30	216
2038	40	82	122	127	34	0	34	215
2039	41	83	124	129	38	0	38	215
2040	42	85	126	131	43	0	43	215

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility’s WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	27	51	78	23	0	0	0	101
2017	28	53	80	23	0	0	0	103
2018	28	54	82	24	0	0	0	106
2019	29	56	84	24	0	0	0	108
2020	29	57	86	25	0	0	0	111
2021	30	58	88	25	0	0	0	113
2022	31	60	90	26	0	0	0	116
2023	31	61	92	26	0	0	0	118
2024	32	63	94	27	0	0	0	121
2025	32	64	96	27	0	0	0	123
2026	33	65	98	28	0	0	0	126
2027	34	67	100	28	0	0	0	128
2028	34	68	102	29	0	0	0	131
2029	35	69	104	29	0	0	0	133
2030	35	71	106	30	0	0	0	136
2031	36	72	108	30	4	0	4	134
2032	37	74	110	31	9	0	9	132
2033	37	75	112	31	13	0	13	131
2034	38	76	114	32	17	0	17	129
2035	38	78	116	32	21	0	21	127
2036	39	79	118	33	26	0	26	125
2037	40	81	120	33	30	0	30	124
2038	40	82	122	34	34	0	34	122
2039	41	83	124	34	38	0	38	120
2040	42	85	126	35	43	0	43	118

3. Rain Barrels
  - **a.** In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
  - **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
East Rio Hondo WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares East Rio Hondo WSC's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) East Rio Hondo WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in East Rio Hondo WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for East Rio Hondo WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	13	25	38	0	0	0	38
2016	26	26	52	0	0	0	52
2017	26	27	54	0	0	0	53
2018	27	28	55	0	0	0	55
2019	27	29	56	0	0	0	56
2020	28	30	58	0	0	0	57
2021	28	31	59	2	0	2	56
2022	28	31	60	4	0	4	55
2023	29	32	60	6	0	6	55
2024	29	32	61	8	0	8	54
2025	30	33	62	10	0	10	53
2026	30	33	63	11	0	11	52
2027	30	34	64	13	0	13	51
2028	31	34	65	15	0	15	50
2029	31	35	66	17	0	17	49
2030	32	35	67	19	0	19	48
2031	32	36	68	25	0	25	43
2032	32	36	69	31	0	31	37
2033	33	37	70	37	0	37	32
2034	33	37	70	43	0	43	27
2035	34	38	71	49	0	49	22
2036	34	38	72	55	0	55	17
2037	35	39	73	62	0	62	12
2038	35	39	74	68	0	68	7
2039	35	40	75	74	0	74	1
2040	36	40	76	80	0	80	(4)
2041	36	41	77	88	0	88	(11)
2042	37	41	78	97	0	97	(19)
2043	37	42	79	105	0	105	(26)
2044	38	42	80	113	0	113	(33)
2045	38	43	81	122	0	122	(41)
2046	39	44	82	130	0	130	(48)
2047	39	44	83	138	0	138	(55)
2048	40	45	84	147	0	147	(63)
2049	40	45	85	155	0	155	(70)
2050	40	46	86	164	0	164	(77)
2051	41	46	87	174	0	174	(87)
2052	41	47	88	185	0	185	(97)
2053	42	47	89	196	0	196	(106)
2054	42	48	90	206	0	206	(116)
2055	43	49	91	217	0	217	(126)
2056	43	49	93	228	0	228	(135)
2057	44	50	94	238	0	238	(145)
2058	44	50	95	249	0	249	(154)
2059	45	51	96	260	0	260	(164)
2060	45	51	97	270	0	270	(174)
2061	46	52	98	283	0	283	(185)
2062	46	53	99	296	0	296	(197)
2063	47	53	100	308	0	308	(208)
2064	47	54	101	321	0	321	(219)
2065	48	54	102	333	0	333	(231)
2066	48	55	103	346	0	346	(242)
2067	49	56	104	358	0	358	(254)
2068	49	56	106	371	0	371	(265)
2069	50	57	107	383	0	383	(277)
2070	50	57	108	396	0	396	(288)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how East Rio Hondo WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	110	0	0	0
1	2015	22,878	108	17	38	22
2	2016	23,789	106	35	52	17
3	2017	24,701	104	54	54	(1)
4	2018	25,612	102	75	55	(20)
5-year Goal	2019	26,524	100	97	56	(40)
6	2020	27,435	99	110	58	(52)
7	2021	27,897	98	122	59	(64)
8	2022	28,358	97	135	60	(75)
9	2023	28,820	96	147	60	(87)
10-year Goal	2024	29,282	95	160	61	(99)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how East Rio Hondo WSC's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	22,878	15.80	2	25	23
2	2016	23,789	15.60	3	26	23
3	2017	24,701	15.40	5	27	22
4	2018	25,612	15.20	7	28	21
5-year Goal	2019	26,524	15.00	10	29	19
6	2020	27,435	14.00	20	30	10
7	2021	27,897	13.00	31	31	0
8	2022	28,358	12.00	41	31	(10)
9	2023	28,820	11.00	53	32	(21)
10-year Goal	2024	29,282	10.00	64	32	(32)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 25 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 5.7% increase in 2014
        ii. 5.4% increase in 2016
    b. Estimated customer demand reduction of 2.22%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2014	13.0	13
2015	13.2	13
2016	26.1	26
2017	26.5	26
2018	26.9	27
2019	27.3	27
2020	27.7	28
2021	28.1	28
2022	28.5	28
2023	28.9	29
2024	29.3	29
2025	29.7	30
2026	30.1	30
2027	30.4	30
2028	30.8	31
2029	31.2	31
2030	31.6	32
2031	32.0	32
2032	32.5	32
2033	32.9	33
2034	33.3	33
2035	33.7	34
2036	34.1	34
2037	34.5	35
2038	35.0	35
2039	35.4	35
2040	35.8	36
2041	36.3	36
2042	36.7	37
2043	37.2	37
2044	37.7	38
2045	38.1	38
2046	38.6	39
2047	39.0	39
2048	39.5	40
2049	40.0	40
2050	40.4	40
2051	40.9	41
2052	41.4	41
2053	41.9	42
2054	42.4	42
2055	42.9	43
2056	43.4	43
2057	43.9	44
2058	44.4	44
2059	44.9	45
2060	45.4	45
2061	45.9	46
2062	46.4	46
2063	46.9	47
2064	47.4	47
2065	47.9	48
2066	48.4	48
2067	48.9	49
2068	49.4	49
2069	49.9	50
2070	50.4	50

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	22,878	13.00	25
2016	23,789	13.00	26
2017	24,701	13.00	27
2018	25,612	13.00	28
2019	26,524	13.00	29
2020	27,435	13.00	30
2021	27,897	13.00	31
2022	28,358	13.00	31
2023	28,820	13.00	32
2024	29,282	13.00	32

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region M savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 59 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	26	26	52	59	0	0	0	111
2017	26	27	54	60	0	0	0	114
2018	27	28	55	61	0	0	0	116
2019	27	29	56	62	0	0	0	118
2020	28	30	58	63	0	0	0	120
2021	28	31	59	64	2	0	2	120
2022	28	31	60	65	4	0	4	120
2023	29	32	60	66	6	0	6	120
2024	29	32	61	67	8	0	8	120
2025	30	33	62	67	10	0	10	120
2026	30	33	63	68	11	0	11	120
2027	30	34	64	69	13	0	13	120
2028	31	34	65	70	15	0	15	120
2029	31	35	66	71	17	0	17	120
2030	32	35	67	72	19	0	19	120
2031	32	36	68	73	25	0	25	116
2032	32	36	69	74	31	0	31	111
2033	33	37	70	75	37	0	37	107
2034	33	37	70	76	43	0	43	103
2035	34	38	71	77	49	0	49	99
2036	34	38	72	78	55	0	55	94
2037	35	39	73	79	62	0	62	90
2038	35	39	74	80	68	0	68	86
2039	35	40	75	80	74	0	74	82
2040	36	40	76	81	80	0	80	78

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	26	26	52	16	0	0	0	68
2017	26	27	54	16	0	0	0	69
2018	27	28	55	16	0	0	0	71
2019	27	29	56	16	0	0	0	73
2020	28	30	58	17	0	0	0	74
2021	28	31	59	17	2	0	2	73
2022	28	31	60	17	4	0	4	73
2023	29	32	60	17	6	0	6	72
2024	29	32	61	18	8	0	8	71
2025	30	33	62	18	10	0	10	71
2026	30	33	63	18	11	0	11	70
2027	30	34	64	18	13	0	13	69
2028	31	34	65	19	15	0	15	68
2029	31	35	66	19	17	0	17	68
2030	32	35	67	19	19	0	19	67
2031	32	36	68	19	25	0	25	62
2032	32	36	69	20	31	0	31	57
2033	33	37	70	20	37	0	37	52
2034	33	37	70	20	43	0	43	47
2035	34	38	71	20	49	0	49	42
2036	34	38	72	21	55	0	55	37
2037	35	39	73	21	62	0	62	33
2038	35	39	74	21	68	0	68	28
2039	35	40	75	21	74	0	74	23
2040	36	40	76	22	80	0	80	18

3. Rain Barrels

- **a.** In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
- **b.** Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Edinburg Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Edinburg's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Edinburg's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Edinburg's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Edinburg with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

---

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

<u>Actual Water Loss Reduction Savings (as of 2015)</u> – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

<u>Total Savings from All Conservation Activity</u> – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

<u>Conservation WMS Volume</u> – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

<u>Water Loss Reduction WMS Volume</u> – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

<u>Total Yearly WMS Volume</u> – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

<u>Over (Short)</u> – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	247	247	0	0	0	247
2016	0	254	254	0	0	0	254
2017	0	262	262	0	0	0	262
2018	0	270	270	0	0	0	270
2019	0	278	278	0	0	0	278
2020	0	285	285	0	0	0	285
2021	0	292	292	3	0	3	290
2022	0	299	299	5	0	5	294
2023	0	306	306	8	0	8	298
2024	0	313	313	11	0	11	302
2025	0	320	320	14	0	14	306
2026	0	327	327	16	0	16	310
2027	0	334	334	19	0	19	315
2028	0	340	340	22	0	22	319
2029	0	347	347	24	0	24	323
2030	0	354	354	27	0	27	327
2031	0	361	361	50	0	50	311
2032	0	368	368	73	0	73	295
2033	0	375	375	96	0	96	279
2034	0	382	382	119	0	119	263
2035	0	389	389	142	0	142	247
2036	0	396	396	165	0	165	231
2037	0	403	403	188	0	188	214
2038	0	410	410	211	0	211	198
2039	0	417	417	234	0	234	182
2040	0	424	424	257	0	257	166
2041	0	430	430	291	0	291	140
2042	0	437	437	324	0	324	114
2043	0	444	444	357	0	357	87
2044	0	451	451	390	0	390	61
2045	0	458	458	424	0	424	35
2046	0	465	465	457	0	457	8
2047	0	472	472	490	0	490	(18)
2048	0	479	479	523	0	523	(44)
2049	0	486	486	556	0	556	(70)
2050	0	493	493	590	0	590	(97)
2051	0	500	500	632	0	632	(133)
2052	0	507	507	675	0	675	(169)
2053	0	514	514	718	0	718	(205)
2054	0	521	521	761	0	761	(240)
2055	0	528	528	804	0	804	(276)
2056	0	535	535	847	0	847	(312)
2057	0	541	541	890	0	890	(348)
2058	0	548	548	933	0	933	(384)
2059	0	555	555	976	0	976	(420)
2060	0	562	562	1,018	0	1,018	(456)
2061	0	569	569	1,069	0	1,069	(500)
2062	0	576	576	1,119	0	1,119	(543)
2063	0	583	583	1,169	0	1,169	(586)
2064	0	589	589	1,219	0	1,219	(630)
2065	0	596	596	1,269	0	1,269	(673)
2066	0	603	603	1,319	0	1,319	(716)
2067	0	609	609	1,369	0	1,369	(760)
2068	0	616	616	1,419	0	1,419	(803)
2069	0	623	623	1,469	0	1,469	(846)
2070	0	630	630	1,519	0	1,519	(890)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Edinburg's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	134	0	0	0
1	2015	84,497	127	210	247	37
2	2016	87,140	120	433	254	(178)
3	2017	89,783	114	669	262	(406)
4	2018	92,425	107	918	270	(648)
5-year Goal	2019	95,068	100	1,180	278	(902)
6	2020	97,711	98	1,284	285	(999)
7	2021	100,073	96	1,388	292	(1,096)
8	2022	102,435	94	1,496	299	(1,196)
9	2023	104,796	92	1,607	306	(1,301)
10-year Goal	2024	107,158	90	1,721	313	(1,408)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Edinburg's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2015	84,497	11.00	31	247	216
2	2016	87,140	10.00	64	254	191
3	2017	89,783	9.00	98	262	164
4	2018	92,425	8.00	135	270	135
5-year Goal	2019	95,068	7.00	173	278	104
6	2020	97,711	6.60	193	285	93
7	2021	100,073	6.20	212	292	80
8	2022	102,435	5.80	232	299	67
9	2023	104,796	5.40	252	306	54
10-year Goal	2024	107,158	5.00	274	313	39

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 247 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	12.00	0
2015	84,497	4.00	247
2016	87,140	4.00	254
2017	89,783	4.00	262
2018	92,425	4.00	270
2019	95,068	4.00	278
2020	97,711	4.00	285
2021	100,073	4.00	292
2022	102,435	4.00	299
2023	104,796	4.00	306
2024	107,158	4.00	313

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 4.84% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 189 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	254	254	189	0	0	0	444
2017	0	262	262	194	0	0	0	456
2018	0	270	270	198	0	0	0	468
2019	0	278	278	202	0	0	0	480
2020	0	285	285	207	0	0	0	492
2021	0	292	292	211	3	0	3	501
2022	0	299	299	216	5	0	5	509
2023	0	306	306	220	8	0	8	518
2024	0	313	313	224	11	0	11	526
2025	0	320	320	229	14	0	14	535
2026	0	327	327	233	16	0	16	544
2027	0	334	334	237	19	0	19	552
2028	0	340	340	242	22	0	22	561
2029	0	347	347	246	24	0	24	569
2030	0	354	354	251	27	0	27	578
2031	0	361	361	255	50	0	50	566
2032	0	368	368	260	73	0	73	555
2033	0	375	375	264	96	0	96	543
2034	0	382	382	269	119	0	119	532
2035	0	389	389	273	142	0	142	520
2036	0	396	396	278	165	0	165	508
2037	0	403	403	282	188	0	188	497
2038	0	410	410	287	211	0	211	485
2039	0	417	417	292	234	0	234	474
2040	0	424	424	296	257	0	257	462

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	254	254	52	0	0	0	307
2017	0	262	262	54	0	0	0	316
2018	0	270	270	55	0	0	0	325
2019	0	278	278	56	0	0	0	334
2020	0	285	285	57	0	0	0	343
2021	0	292	292	58	3	0	3	348
2022	0	299	299	60	5	0	5	353
2023	0	306	306	61	8	0	8	359
2024	0	313	313	62	11	0	11	364
2025	0	320	320	63	14	0	14	370
2026	0	327	327	65	16	0	16	375
2027	0	334	334	66	19	0	19	380
2028	0	340	340	67	22	0	22	386
2029	0	347	347	68	24	0	24	391
2030	0	354	354	69	27	0	27	397
2031	0	361	361	71	50	0	50	382
2032	0	368	368	72	73	0	73	367
2033	0	375	375	73	96	0	96	352
2034	0	382	382	74	119	0	119	337
2035	0	389	389	76	142	0	142	322
2036	0	396	396	77	165	0	165	307
2037	0	403	403	78	188	0	188	293
2038	0	410	410	79	211	0	211	278
2039	0	417	417	81	234	0	234	263
2040	0	424	424	82	257	0	257	248

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 78 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases..

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	254	254	78	0	0	0	333
2017	0	262	262	80	0	0	0	342
2018	0	270	270	82	0	0	0	352
2019	0	278	278	84	0	0	0	361
2020	0	285	285	85	0	0	0	371
2021	0	292	292	87	3	0	3	377
2022	0	299	299	89	5	0	5	383
2023	0	306	306	91	8	0	8	389
2024	0	313	313	93	11	0	11	395
2025	0	320	320	95	14	0	14	401
2026	0	327	327	96	16	0	16	407
2027	0	334	334	98	19	0	19	413
2028	0	340	340	100	22	0	22	419
2029	0	347	347	102	24	0	24	425
2030	0	354	354	104	27	0	27	431
2031	0	361	361	105	50	0	50	417
2032	0	368	368	107	73	0	73	402
2033	0	375	375	109	96	0	96	388
2034	0	382	382	111	119	0	119	374
2035	0	389	389	113	142	0	142	360
2036	0	396	396	115	165	0	165	345
2037	0	403	403	117	188	0	188	331
2038	0	410	410	119	211	0	211	317
2039	0	417	417	120	234	0	234	303
2040	0	424	424	122	257	0	257	288

4. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

TWDB Statewide Water Conservation Quantification Project
Hildalgo County MUD #1 Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Hildalgo County MUD #1's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Hildalgo County MUD #1's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Hildalgo County MUD #1's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Hildalgo County MUD #1 with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	18	18	25	0	25	(7)
2016	0	18	18	31	0	31	(13)
2017	0	18	18	31	0	31	(13)
2018	0	18	18	37	0	37	(19)
2019	0	18	18	43	0	43	(25)
2020	0	18	18	56	0	56	(37)
2021	0	18	18	56	0	56	(38)
2022	0	18	18	57	0	57	(38)
2023	0	18	18	57	0	57	(39)
2024	0	18	18	58	0	58	(39)
2025	0	18	18	58	0	58	(40)
2026	0	19	19	59	0	59	(40)
2027	0	19	19	59	0	59	(41)
2028	0	19	19	60	0	60	(41)
2029	0	19	19	60	0	60	(42)
2030	0	19	19	61	0	61	(42)
2031	0	19	19	61	0	61	(42)
2032	0	19	19	62	0	62	(43)
2033	0	20	20	63	0	63	(43)
2034	0	20	20	63	0	63	(43)
2035	0	20	20	64	0	64	(43)
2036	0	21	21	64	0	64	(43)
2037	0	21	21	65	0	65	(44)
2038	0	22	22	65	0	65	(44)
2039	0	22	22	66	0	66	(44)
2040	0	22	22	66	0	66	(44)
2041	0	23	23	67	0	67	(44)
2042	0	23	23	68	0	68	(45)
2043	0	23	23	68	0	68	(45)
2044	0	24	24	69	0	69	(45)
2045	0	24	24	69	0	69	(45)
2046	0	24	24	70	0	70	(45)
2047	0	25	25	70	0	70	(46)
2048	0	25	25	71	0	71	(46)
2049	0	26	26	71	0	71	(46)
2050	0	26	26	72	0	72	(46)
2051	0	26	26	73	0	73	(46)
2052	0	27	27	73	0	73	(46)
2053	0	27	27	74	0	74	(47)
2054	0	27	27	74	0	74	(47)
2055	0	28	28	75	0	75	(47)
2056	0	28	28	75	0	75	(47)
2057	0	29	29	76	0	76	(47)
2058	0	29	29	76	0	76	(48)
2059	0	29	29	77	0	77	(48)
2060	0	30	30	78	0	78	(48)
2061	0	30	30	80	0	80	(50)
2062	0	30	30	82	0	82	(52)
2063	0	31	31	85	0	85	(54)
2064	0	31	31	87	0	87	(56)
2065	0	31	31	90	0	90	(58)
2066	0	32	32	92	0	92	(60)
2067	0	32	32	94	0	94	(62)
2068	0	32	32	97	0	97	(64)
2069	0	33	33	99	0	99	(66)
2070	0	33	33	102	0	102	(69)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Canyon's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	77	0	0	0
1	2016	8,258	76	4	18	14
2	2017	8,287	74	8	18	10
3	2018	8,315	73	13	18	5
4	2019	8,344	71	17	18	1
5-year Goal	2020	8,373	70	21	18	(3)
6	2021	8,387	69	24	18	(6)
7	2022	8,402	68	28	18	(9)
8	2023	8,416	67	31	18	(12)
9	2024	8,430	66	34	18	(15)
10-year Goal	2025	8,445	65	37	18	(18)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Hildalgo County MUD #1's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2016	8,258	13.00	3	18	15
2	2017	8,287	12.00	6	18	12
3	2018	8,315	11.00	9	18	9
4	2019	8,344	10.00	12	18	6
5-year Goal	2020	8,373	9.00	15	18	3
6	2021	8,387	8.60	17	18	2
7	2022	8,402	8.20	18	18	1
8	2023	8,416	7.80	19	18	(1)
9	2024	8,430	7.40	20	18	(2)
10-year Goal	2025	8,445	7.00	22	18	(3)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 18 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	14.00	0
2015	8,229	8.00	18
2016	8,258	8.00	18
2017	8,287	8.00	18
2018	8,315	8.00	18
2019	8,344	8.00	18
2020	8,373	8.00	18
2021	8,387	8.00	18
2022	8,402	8.00	18
2023	8,416	8.00	18
2024	8,430	8.00	18

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        - i. Average Region M savings
        - ii. Specific percentage of outdoor usage unknown for your utility at this time
    - **b.** Savings could be 9 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	18	18	9	31	0	31	(4)
2017	0	18	18	9	31	0	31	(4)
2018	0	18	18	9	37	0	37	(10)
2019	0	18	18	9	43	0	43	(16)
2020	0	18	18	9	56	0	56	(28)
2021	0	18	18	10	56	0	56	(28)
2022	0	18	18	10	57	0	57	(29)
2023	0	18	18	10	57	0	57	(29)
2024	0	18	18	10	58	0	58	(29)
2025	0	18	18	10	58	0	58	(30)
2026	0	19	19	10	59	0	59	(30)
2027	0	19	19	11	59	0	59	(30)
2028	0	19	19	11	60	0	60	(30)
2029	0	19	19	11	60	0	60	(31)
2030	0	19	19	11	61	0	61	(31)
2031	0	19	19	11	61	0	61	(31)
2032	0	19	19	12	62	0	62	(31)
2033	0	20	20	12	63	0	63	(31)
2034	0	20	20	12	63	0	63	(31)
2035	0	20	20	12	64	0	64	(31)
2036	0	21	21	12	64	0	64	(31)
2037	0	21	21	13	65	0	65	(31)
2038	0	22	22	13	65	0	65	(31)
2039	0	22	22	13	66	0	66	(31)
2040	0	22	22	13	66	0	66	(31)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	18	18	2	31	0	31	(11)
2017	0	18	18	2	31	0	31	(10)
2018	0	18	18	2	37	0	37	(17)
2019	0	18	18	2	43	0	43	(23)
2020	0	18	18	2	56	0	56	(35)
2021	0	18	18	3	56	0	56	(35)
2022	0	18	18	3	57	0	57	(36)
2023	0	18	18	3	57	0	57	(36)
2024	0	18	18	3	58	0	58	(37)
2025	0	18	18	3	58	0	58	(37)
2026	0	19	19	3	59	0	59	(38)
2027	0	19	19	3	59	0	59	(38)
2028	0	19	19	3	60	0	60	(38)
2029	0	19	19	3	60	0	60	(39)
2030	0	19	19	3	61	0	61	(39)
2031	0	19	19	3	61	0	61	(39)
2032	0	19	19	3	62	0	62	(40)
2033	0	20	20	3	63	0	63	(40)
2034	0	20	20	3	63	0	63	(40)
2035	0	20	20	3	64	0	64	(40)
2036	0	21	21	3	64	0	64	(40)
2037	0	21	21	3	65	0	65	(40)
2038	0	22	22	3	65	0	65	(40)
2039	0	22	22	3	66	0	66	(41)
2040	0	22	22	3	66	0	66	(41)

3. Water Rate Increase

a. For every 10% increase, estimated savings could be 2% of utility total demand.

b. Approximately 3 MG of savings per year with current demand

c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)

d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	18	18	3	31	0	31	(9)
2017	0	18	18	3	31	0	31	(9)
2018	0	18	18	4	37	0	37	(15)
2019	0	18	18	4	43	0	43	(21)
2020	0	18	18	4	56	0	56	(34)
2021	0	18	18	4	56	0	56	(34)
2022	0	18	18	4	57	0	57	(35)
2023	0	18	18	4	57	0	57	(35)
2024	0	18	18	4	58	0	58	(35)
2025	0	18	18	4	58	0	58	(36)
2026	0	19	19	4	59	0	59	(36)
2027	0	19	19	4	59	0	59	(37)
2028	0	19	19	4	60	0	60	(37)
2029	0	19	19	4	60	0	60	(37)
2030	0	19	19	4	61	0	61	(38)
2031	0	19	19	5	61	0	61	(38)
2032	0	19	19	5	62	0	62	(38)
2033	0	20	20	5	63	0	63	(38)
2034	0	20	20	5	63	0	63	(38)
2035	0	20	20	5	64	0	64	(38)
2036	0	21	21	5	64	0	64	(39)
2037	0	21	21	5	65	0	65	(39)
2038	0	22	22	5	65	0	65	(39)
2039	0	22	22	5	66	0	66	(39)
2040	0	22	22	5	66	0	66	(39)

4. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Laredo Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Laredo's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Laredo's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Laredo's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report..

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities..

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Laredo with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	61	391	452	0	0	0	452
2016	112	401	513	0	0	0	513
2017	114	410	524	0	0	0	524
2018	117	419	536	0	0	0	536
2019	118	429	546	0	0	0	546
2020	120	438	558	0	0	0	558
2021	122	448	570	0	0	0	570
2022	124	459	583	0	0	0	583
2023	126	469	596	0	0	0	596
2024	129	479	608	0	0	0	608
2025	131	490	621	0	0	0	621
2026	133	500	633	0	0	0	633
2027	135	510	646	0	0	0	646
2028	138	521	658	0	0	0	658
2029	140	531	671	0	0	0	671
2030	142	542	684	0	0	0	684
2031	144	551	696	0	0	0	696
2032	146	561	708	0	0	0	708
2033	148	571	720	0	0	0	720
2034	151	581	732	0	0	0	732
2035	153	591	744	0	0	0	744
2036	155	601	756	0	0	0	756
2037	157	611	768	0	0	0	768
2038	159	621	780	0	0	0	780
2039	161	630	792	0	0	0	792
2040	163	640	804	0	0	0	804
2041	165	649	815	85	0	85	730
2042	168	658	826	169	0	169	656
2043	170	667	837	254	0	254	583
2044	172	676	848	339	0	339	509
2045	174	685	859	424	0	424	435
2046	176	694	870	508	0	508	361
2047	178	703	881	593	0	593	288
2048	180	712	892	678	0	678	214
2049	182	721	903	763	0	763	140
2050	184	730	914	847	0	847	67
2051	186	739	924	966	0	966	(42)
2052	188	747	935	1,085	0	1,085	(150)
2053	190	756	945	1,203	0	1,203	(258)
2054	192	764	956	1,322	0	1,322	(366)
2055	194	773	966	1,441	0	1,441	(475)
2056	196	781	977	1,559	0	1,559	(583)
2057	197	790	987	1,678	0	1,678	(691)
2058	199	798	998	1,797	0	1,797	(799)
2059	201	807	1,008	1,916	0	1,916	(907)
2060	203	815	1,019	2,034	0	2,034	(1,016)
2061	205	823	1,028	2,170	0	2,170	(1,142)
2062	207	830	1,037	2,305	0	2,305	(1,268)
2063	209	838	1,047	2,441	0	2,441	(1,394)
2064	211	846	1,056	2,576	0	2,576	(1,520)
2065	212	853	1,066	2,711	0	2,711	(1,646)
2066	214	861	1,075	2,847	0	2,847	(1,772)
2067	216	869	1,085	2,982	0	2,982	(1,898)
2068	218	876	1,094	3,118	0	3,118	(2,024)
2069	220	884	1,103	3,253	0	3,253	(2,149)
2070	221	892	1,113	3,388	0	3,388	(2,275)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Laredo's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	268,030	146	391	452	61
2	2016	274,418	142	801	513	(289)
3	2017	280,806	138	1,230	524	(706)
4	2018	287,193	134	1,677	536	(1,141)
5-year Goal	2019	293,581	130	2,143	546	(1,597)
6	2020	299,969	126	2,628	558	(2,070)
7	2021	307,067	122	3,138	570	(2,568)
8	2022	314,166	118	3,669	583	(3,086)
9	2023	321,264	114	4,221	596	(3,626)
10-year Goal	2024	328,362	110	4,794	608	(4,186)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Laredo's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	18.00	0	0	0
1	2015	268,030	17.00	98	391	293
2	2016	274,418	16.00	200	401	200
3	2017	280,806	15.00	307	410	102
4	2018	287,193	14.00	419	419	0
5-year Goal	2019	293,581	13.00	536	429	(107)
6	2020	299,969	12.20	635	438	(197)
7	2021	307,067	11.40	740	448	(291)
8	2022	314,166	10.60	849	459	(390)
9	2023	321,264	9.80	962	469	(492)
10-year Goal	2024	328,362	9.00	1,079	479	(599)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
  - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
  - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
  - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 391 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 2.0% increase in 2015
        ii. 2.0% increase in 2016
    b. Estimated customer demand reduction of .8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases..

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

6. WaterWise Take-home Kits

a. Estimated savings of 7,384 gallons per year per kit (Frontier Associates, 2015)
b. Conservative 5-year useful life for all items in kit
c. 15% adoption rate assumed

7. High Efficiency (HE) Toilet Replacement Program

a. Estimated 10,390 gallons per year per toilet (A&N Technical Services, 2005)
b. Number of replacements per year provided by staff
c. Savings carry on indefinitely because replacement toilet will be as efficient

8. Showerhead Distribution (SF)

a. Estimated 2,050 gallons per year per showerhead (A&N Technical Services, 2005)
b. 5-year useful life
    i. If distributed after 2009, plumbing code will require that replacement is equally as efficient, so savings will carry forward indefinitely

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	HE Toilets (Residential)	Low Flow Showerheads (Residential)	WaterWise Take-home Kits	TOTAL SAVINGS
2009					0
2010					0
2011					0
2012					0
2013		1.1			1
2014		4.3	2.1	1.1	7
2015	49	6.6	4.1	1.1	61
2016	100	6.6	4.1	1.1	112
2017	103	6.6	4.1	1.1	114
2018	105	6.6	4.1	1.1	117
2019	107	6.6	4.1		118
2020	109	6.6	4.1		120
2021	111	6.6	4.1		122
2022	114	6.6	4.1		124
2023	116	6.6	4.1		126
2024	118	6.6	4.1		129
2025	120	6.6	4.1		131
2026	122	6.6	4.1		133
2027	125	6.6	4.1		135
2028	127	6.6	4.1		138
2029	129	6.6	4.1		140
2030	131	6.6	4.1		142
2031	133	6.6	4.1		144
2032	136	6.6	4.1		146
2033	138	6.6	4.1		148
2034	140	6.6	4.1		151
2035	142	6.6	4.1		153
2036	144	6.6	4.1		155
2037	146	6.6	4.1		157
2038	148	6.6	4.1		159
2039	151	6.6	4.1		161
2040	153	6.6	4.1		163
2041	155	6.6	4.1		165
2042	157	6.6	4.1		168
2043	159	6.6	4.1		170
2044	161	6.6	4.1		172
2045	163	6.6	4.1		174
2046	165	6.6	4.1		176
2047	167	6.6	4.1		178
2048	169	6.6	4.1		180
2049	171	6.6	4.1		182
2050	173	6.6	4.1		184
2051	175	6.6	4.1		186
2052	177	6.6	4.1		188
2053	179	6.6	4.1		190
2054	181	6.6	4.1		192
2055	183	6.6	4.1		194
2056	185	6.6	4.1		196
2057	187	6.6	4.1		197
2058	189	6.6	4.1		199
2059	191	6.6	4.1		201
2060	193	6.6	4.1		203
2061	194	6.6	4.1		205
2062	196	6.6	4.1		207
2063	198	6.6	4.1		209
2064	200	6.6	4.1		211
2065	202	6.6	4.1		212
2066	203	6.6	4.1		214
2067	205	6.6	4.1		216
2068	207	6.6	4.1		218
2069	209	6.6	4.1		220
2070	211	6.6	4.1		221

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	18.00	0
2015	268,030	14.00	391
2016	274,418	14.00	401
2017	280,806	14.00	410
2018	287,193	14.00	419
2019	293,581	14.00	429
2020	299,969	14.00	438
2021	307,067	14.00	448
2022	314,166	14.00	459
2023	321,264	14.00	469
2024	328,362	14.00	479

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.47% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   b. Savings could be 686 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	112	401	513	686	0	0	0	1,199
2017	114	410	524	701	0	0	0	1,225
2018	117	419	536	716	0	0	0	1,252
2019	118	429	546	731	0	0	0	1,278
2020	120	438	558	746	0	0	0	1,304
2021	122	448	570	761	0	0	0	1,332
2022	124	459	583	777	0	0	0	1,360
2023	126	469	596	792	0	0	0	1,387
2024	129	479	608	807	0	0	0	1,415
2025	131	490	621	822	0	0	0	1,443
2026	133	500	633	837	0	0	0	1,470
2027	135	510	646	852	0	0	0	1,498
2028	138	521	658	867	0	0	0	1,526
2029	140	531	671	882	0	0	0	1,553
2030	142	542	684	897	0	0	0	1,581
2031	144	551	696	912	0	0	0	1,608
2032	146	561	708	927	0	0	0	1,634
2033	148	571	720	941	0	0	0	1,661
2034	151	581	732	956	0	0	0	1,688
2035	153	591	744	971	0	0	0	1,715
2036	155	601	756	986	0	0	0	1,741
2037	157	611	768	1,000	0	0	0	1,768
2038	159	621	780	1,015	0	0	0	1,795
2039	161	630	792	1,030	0	0	0	1,821
2040	163	640	804	1,044	0	0	0	1,848

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	112	401	513	168	0	0	0	681
2017	114	410	524	172	0	0	0	696
2018	117	419	536	175	0	0	0	711
2019	118	429	546	179	0	0	0	725
2020	120	438	558	183	0	0	0	741
2021	122	448	570	187	0	0	0	757
2022	124	459	583	190	0	0	0	773
2023	126	469	596	194	0	0	0	789
2024	129	479	608	198	0	0	0	806
2025	131	490	621	201	0	0	0	822
2026	133	500	633	205	0	0	0	838
2027	135	510	646	209	0	0	0	855
2028	138	521	658	212	0	0	0	871
2029	140	531	671	216	0	0	0	887
2030	142	542	684	220	0	0	0	903
2031	144	551	696	223	0	0	0	919
2032	146	561	708	227	0	0	0	935
2033	148	571	720	231	0	0	0	950
2034	151	581	732	234	0	0	0	966
2035	153	591	744	238	0	0	0	981
2036	155	601	756	241	0	0	0	997
2037	157	611	768	245	0	0	0	1,013
2038	159	621	780	249	0	0	0	1,028
2039	161	630	792	252	0	0	0	1,044
2040	163	640	804	256	0	0	0	1,060

3. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of McAllen Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares McAllen's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) McAllen's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in McAllen's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for McAllen with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

---

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	270	(358)	(89)	242	0	242	(331)
2016	276	(371)	(94)	303	0	303	(398)
2017	283	(383)	(100)	303	0	303	(403)
2018	290	(396)	(106)	364	0	364	(470)
2019	296	(408)	(112)	424	0	424	(536)
2020	303	(421)	(118)	546	0	546	(663)
2021	310	(431)	(121)	674	0	674	(795)
2022	316	(441)	(125)	802	0	802	(927)
2023	323	(451)	(128)	930	0	930	(1,058)
2024	329	(461)	(132)	1,058	0	1,058	(1,190)
2025	336	(471)	(135)	1,187	0	1,187	(1,322)
2026	343	(482)	(139)	1,315	0	1,315	(1,454)
2027	349	(492)	(142)	1,443	0	1,443	(1,585)
2028	356	(502)	(146)	1,571	0	1,571	(1,717)
2029	363	(512)	(149)	1,699	0	1,699	(1,849)
2030	369	(522)	(153)	1,828	0	1,828	(1,981)
2031	376	(532)	(156)	2,000	0	2,000	(2,156)
2032	383	(543)	(160)	2,172	0	2,172	(2,332)
2033	390	(553)	(163)	2,344	0	2,344	(2,507)
2034	396	(563)	(167)	2,516	0	2,516	(2,683)
2035	403	(573)	(170)	2,688	0	2,688	(2,858)
2036	410	(583)	(173)	2,860	0	2,860	(3,034)
2037	417	(594)	(177)	3,032	0	3,032	(3,209)
2038	423	(604)	(180)	3,204	0	3,204	(3,385)
2039	430	(614)	(184)	3,376	0	3,376	(3,560)
2040	437	(624)	(187)	3,548	0	3,548	(3,736)
2041	444	(634)	(191)	3,760	0	3,760	(3,950)
2042	451	(645)	(194)	3,971	0	3,971	(4,165)
2043	458	(655)	(197)	4,182	0	4,182	(4,379)
2044	465	(665)	(200)	4,394	0	4,394	(4,594)
2045	472	(675)	(204)	4,605	0	4,605	(4,809)
2046	479	(686)	(207)	4,816	0	4,816	(5,023)
2047	485	(696)	(210)	5,028	0	5,028	(5,238)
2048	492	(706)	(214)	5,239	0	5,239	(5,453)
2049	499	(716)	(217)	5,450	0	5,450	(5,667)
2050	506	(727)	(220)	5,662	0	5,662	(5,882)
2051	513	(737)	(223)	5,874	0	5,874	(6,098)
2052	520	(747)	(227)	6,087	0	6,087	(6,314)
2053	527	(757)	(230)	6,300	0	6,300	(6,530)
2054	534	(767)	(233)	6,513	0	6,513	(6,746)
2055	542	(778)	(236)	6,726	0	6,726	(6,962)
2056	549	(788)	(239)	6,939	0	6,939	(7,178)
2057	556	(798)	(242)	7,152	0	7,152	(7,394)
2058	563	(808)	(246)	7,365	0	7,365	(7,610)
2059	570	(819)	(249)	7,577	0	7,577	(7,826)
2060	577	(829)	(252)	7,790	0	7,790	(8,042)
2061	584	(839)	(255)	7,972	0	7,972	(8,227)
2062	591	(849)	(258)	8,153	0	8,153	(8,411)
2063	598	(859)	(261)	8,334	0	8,334	(8,595)
2064	604	(869)	(264)	8,516	0	8,516	(8,780)
2065	611	(878)	(267)	8,697	0	8,697	(8,964)
2066	618	(888)	(270)	8,878	0	8,878	(9,149)
2067	625	(898)	(273)	9,060	0	9,060	(9,333)
2068	632	(908)	(276)	9,241	0	9,241	(9,517)
2069	639	(918)	(279)	9,422	0	9,422	(9,702)
2070	646	(928)	(282)	9,604	0	9,604	(9,886)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how McAllen's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	136	0	0	0
1	2015	140,269	142	(297)	(89)	208
2	2016	145,135	148	(614)	(94)	520
3	2017	150,000	153	(953)	(100)	852
4	2018	154,866	159	(1,311)	(106)	1,205
5-year Goal	2019	159,731	165	(1,691)	(112)	1,579
6	2020	164,597	164	(1,682)	(118)	1,565
7	2021	168,576	163	(1,661)	(121)	1,540
8	2022	172,554	162	(1,638)	(125)	1,513
9	2023	176,533	161	(1,611)	(128)	1,483
10-year Goal	2024	180,511	160	(1,581)	(132)	1,450

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how McAllen's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14.00	0	0	0
1	2015	140,269	13.80	10	(358)	(369)
2	2016	145,135	13.60	21	(371)	(392)
3	2017	150,000	13.40	33	(383)	(416)
4	2018	154,866	13.20	45	(396)	(441)
5-year Goal	2019	159,731	13.00	58	(408)	(466)
6	2020	164,597	13.00	60	(421)	(481)
7	2021	168,576	13.00	62	(431)	(492)
8	2022	172,554	13.00	63	(441)	(504)
9	2023	176,533	13.00	64	(451)	(515)
10-year Goal	2024	180,511	13.00	66	(461)	(527)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 358 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 12.0% increase in 2015
    b. Estimated customer demand reduction of 2.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2015	270	270
2016	276	276
2017	283	283
2018	290	290
2019	296	296
2020	303	303
2021	310	310
2022	316	316
2023	323	323
2024	329	329
2025	336	336
2026	343	343
2027	349	349
2028	356	356
2029	363	363
2030	369	369
2031	376	376
2032	383	383
2033	390	390
2034	396	396
2035	403	403
2036	410	410
2037	417	417
2038	423	423
2039	430	430
2040	437	437
2041	444	444
2042	451	451
2043	458	458
2044	465	465
2045	472	472
2046	479	479
2047	485	485
2048	492	492
2049	499	499
2050	506	506
2051	513	513
2052	520	520
2053	527	527
2054	534	534
2055	542	542
2056	549	549
2057	556	556
2058	563	563
2059	570	570
2060	577	577
2061	584	584
2062	591	591
2063	598	598
2064	604	604
2065	611	611
2066	618	618
2067	625	625
2068	632	632
2069	639	639
2070	646	646

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14	0
2015	140,269	21	(358)
2016	145,135	21	(371)
2017	150,000	21	(383)
2018	154,866	21	(396)
2019	159,731	21	(408)
2020	164,597	21	(421)
2021	168,576	21	(431)
2022	172,554	21	(441)
2023	176,533	21	(451)
2024	180,511	21	(461)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 581 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	276	(371)	(94)	581	303	0	303	184
2017	283	(383)	(100)	595	303	0	303	192
2018	290	(396)	(106)	609	364	0	364	140
2019	296	(408)	(112)	623	424	0	424	87
2020	303	(421)	(118)	637	546	0	546	(26)
2021	310	(431)	(121)	651	674	0	674	(144)
2022	316	(441)	(125)	665	802	0	802	(261)
2023	323	(451)	(128)	679	930	0	930	(379)
2024	329	(461)	(132)	693	1,058	0	1,058	(497)
2025	336	(471)	(135)	707	1,187	0	1,187	(615)
2026	343	(482)	(139)	721	1,315	0	1,315	(732)
2027	349	(492)	(142)	735	1,443	0	1,443	(850)
2028	356	(502)	(146)	749	1,571	0	1,571	(968)
2029	363	(512)	(149)	763	1,699	0	1,699	(1,086)
2030	369	(522)	(153)	777	1,828	0	1,828	(1,203)
2031	376	(532)	(156)	791	2,000	0	2,000	(1,365)
2032	383	(543)	(160)	806	2,172	0	2,172	(1,526)
2033	390	(553)	(163)	820	2,344	0	2,344	(1,687)
2034	396	(563)	(167)	834	2,516	0	2,516	(1,848)
2035	403	(573)	(170)	848	2,688	0	2,688	(2,010)
2036	410	(583)	(173)	863	2,860	0	2,860	(2,171)
2037	417	(594)	(177)	877	3,032	0	3,032	(2,332)
2038	423	(604)	(180)	891	3,204	0	3,204	(2,494)
2039	430	(614)	(184)	905	3,376	0	3,376	(2,655)
2040	437	(624)	(187)	920	3,548	0	3,548	(2,816)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	276	(371)	(94)	154	303	0	303	(243)
2017	283	(383)	(100)	158	303	0	303	(245)
2018	290	(396)	(106)	162	364	0	364	(308)
2019	296	(408)	(112)	165	424	0	424	(371)
2020	303	(421)	(118)	169	546	0	546	(494)
2021	310	(431)	(121)	173	674	0	674	(622)
2022	316	(441)	(125)	177	802	0	802	(750)
2023	323	(451)	(128)	180	930	0	930	(878)
2024	329	(461)	(132)	184	1,058	0	1,058	(1,006)
2025	336	(471)	(135)	188	1,187	0	1,187	(1,134)
2026	343	(482)	(139)	191	1,315	0	1,315	(1,262)
2027	349	(492)	(142)	195	1,443	0	1,443	(1,390)
2028	356	(502)	(146)	199	1,571	0	1,571	(1,518)
2029	363	(512)	(149)	203	1,699	0	1,699	(1,646)
2030	369	(522)	(153)	206	1,828	0	1,828	(1,774)
2031	376	(532)	(156)	210	2,000	0	2,000	(1,946)
2032	383	(543)	(160)	214	2,172	0	2,172	(2,118)
2033	390	(553)	(163)	218	2,344	0	2,344	(2,289)
2034	396	(563)	(167)	221	2,516	0	2,516	(2,461)
2035	403	(573)	(170)	225	2,688	0	2,688	(2,633)
2036	410	(583)	(173)	229	2,860	0	2,860	(2,805)
2037	417	(594)	(177)	233	3,032	0	3,032	(2,976)
2038	423	(604)	(180)	236	3,204	0	3,204	(3,148)
2039	430	(614)	(184)	240	3,376	0	3,376	(3,320)
2040	437	(624)	(187)	244	3,548	0	3,548	(3,492)

3. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Mission Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Mission's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Mission's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Mission's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows a 2070 outlook for Mission with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

---

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	426	426	134	0	134	292
2016	0	440	440	167	0	167	273
2017	0	455	455	167	0	167	288
2018	0	470	470	201	0	201	269
2019	0	484	484	234	0	234	250
2020	0	499	499	301	0	301	198
2021	0	511	511	371	0	371	141
2022	0	523	523	440	0	440	83
2023	0	535	535	509	0	509	26
2024	0	547	547	578	0	578	(31)
2025	0	559	559	647	0	647	(88)
2026	0	571	571	716	0	716	(145)
2027	0	583	583	785	0	785	(202)
2028	0	596	596	854	0	854	(259)
2029	0	608	608	924	0	924	(316)
2030	0	620	620	993	0	993	(373)
2031	0	632	632	1,085	0	1,085	(453)
2032	0	644	644	1,177	0	1,177	(533)
2033	0	656	656	1,269	0	1,269	(613)
2034	0	668	668	1,361	0	1,361	(693)
2035	0	680	680	1,454	0	1,454	(773)
2036	0	692	692	1,546	0	1,546	(853)
2037	0	704	704	1,638	0	1,638	(933)
2038	0	717	717	1,730	0	1,730	(1,013)
2039	0	729	729	1,822	0	1,822	(1,094)
2040	0	741	741	1,914	0	1,914	(1,174)
2041	0	753	753	1,997	0	1,997	(1,245)
2042	0	765	765	2,081	0	2,081	(1,316)
2043	0	777	777	2,164	0	2,164	(1,386)
2044	0	789	789	2,247	0	2,247	(1,457)
2045	0	801	801	2,330	0	2,330	(1,528)
2046	0	814	814	2,413	0	2,413	(1,599)
2047	0	826	826	2,496	0	2,496	(1,670)
2048	0	838	838	2,579	0	2,579	(1,741)
2049	0	850	850	2,662	0	2,662	(1,812)
2050	0	862	862	2,745	0	2,745	(1,883)
2051	0	874	874	2,829	0	2,829	(1,955)
2052	0	886	886	2,912	0	2,912	(2,026)
2053	0	899	899	2,996	0	2,996	(2,097)
2054	0	911	911	3,079	0	3,079	(2,168)
2055	0	923	923	3,163	0	3,163	(2,240)
2056	0	935	935	3,246	0	3,246	(2,311)
2057	0	947	947	3,329	0	3,329	(2,382)
2058	0	959	959	3,413	0	3,413	(2,454)
2059	0	971	971	3,496	0	3,496	(2,525)
2060	0	983	983	3,580	0	3,580	(2,596)
2061	0	995	995	3,671	0	3,671	(2,676)
2062	0	1,007	1,007	3,763	0	3,763	(2,756)
2063	0	1,019	1,019	3,855	0	3,855	(2,836)
2064	0	1,031	1,031	3,947	0	3,947	(2,916)
2065	0	1,042	1,042	4,038	0	4,038	(2,996)
2066	0	1,054	1,054	4,130	0	4,130	(3,076)
2067	0	1,066	1,066	4,222	0	4,222	(3,156)
2068	0	1,078	1,078	4,314	0	4,314	(3,236)
2069	0	1,090	1,090	4,405	0	4,405	(3,316)
2070	0	1,101	1,101	4,497	0	4,497	(3,396)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Mission's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	150	0	0	0
1	2015	83,298	148	46	426	380
2	2016	86,170	147	94	440	346
3	2017	89,042	145	146	455	309
4	2018	91,914	144	201	470	268
5-year Goal	2019	94,786	142	259	484	225
6	2020	97,658	141	310	499	189
7	2021	100,019	140	361	511	150
8	2022	102,379	138	415	523	108
9	2023	104,740	137	470	535	65
10-year Goal	2024	107,100	136	528	547	20

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Mission's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	24.00	0	0	0
1	2015	83,298	23.76	7	426	418
2	2016	86,170	23.52	15	440	425
3	2017	89,042	23.28	23	455	432
4	2018	91,914	23.04	32	470	437
5-year Goal	2019	94,786	22.80	42	484	443
6	2020	97,658	22.56	51	499	448
7	2021	100,019	22.32	61	511	450
8	2022	102,379	22.08	72	523	451
9	2023	104,740	21.84	83	535	453
10-year Goal	2024	107,100	21.60	94	547	453

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 426 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	24.00	0
2015	83,298	10.00	426
2016	86,170	10.00	440
2017	89,042	10.00	455
2018	91,914	10.00	470
2019	94,786	10.00	484
2020	97,658	10.00	499
2021	100,019	10.00	511
2022	102,379	10.00	523
2023	104,740	10.00	535
2024	107,100	10.00	547

[15] If current water loss levels exceed a utility's baseline, this vaue is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
   i. Average Region M savings
   ii. Specific percentage of outdoor usage unknown for your utility at this time
b. Savings could be 303 MG per year with current demand.
c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	440	440	303	167	0	167	576
2017	0	455	455	310	167	0	167	598
2018	0	470	470	318	201	0	201	587
2019	0	484	484	325	234	0	234	575
2020	0	499	499	333	301	0	301	530
2021	0	511	511	340	371	0	371	481
2022	0	523	523	347	440	0	440	431
2023	0	535	535	355	509	0	509	381
2024	0	547	547	362	578	0	578	332
2025	0	559	559	370	647	0	647	282
2026	0	571	571	377	716	0	716	232
2027	0	583	583	384	785	0	785	183
2028	0	596	596	392	854	0	854	133
2029	0	608	608	399	924	0	924	83
2030	0	620	620	407	993	0	993	34
2031	0	632	632	414	1,085	0	1,085	(39)
2032	0	644	644	422	1,177	0	1,177	(111)
2033	0	656	656	429	1,269	0	1,269	(184)
2034	0	668	668	437	1,361	0	1,361	(256)
2035	0	680	680	444	1,454	0	1,454	(329)
2036	0	692	692	452	1,546	0	1,546	(402)
2037	0	704	704	459	1,638	0	1,638	(474)
2038	0	717	717	467	1,730	0	1,730	(547)
2039	0	729	729	475	1,822	0	1,822	(619)
2040	0	741	741	482	1,914	0	1,914	(692)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year[17]
g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	440	440	80	167	0	167	353
2017	0	455	455	82	167	0	167	370
2018	0	470	470	84	201	0	201	353
2019	0	484	484	86	234	0	234	336
2020	0	499	499	88	301	0	301	286
2021	0	511	511	90	371	0	371	231
2022	0	523	523	92	440	0	440	176
2023	0	535	535	94	509	0	509	121
2024	0	547	547	96	578	0	578	65
2025	0	559	559	98	647	0	647	10
2026	0	571	571	100	716	0	716	(45)
2027	0	583	583	102	785	0	785	(100)
2028	0	596	596	104	854	0	854	(155)
2029	0	608	608	106	924	0	924	(210)
2030	0	620	620	108	993	0	993	(265)
2031	0	632	632	110	1,085	0	1,085	(343)
2032	0	644	644	112	1,177	0	1,177	(421)
2033	0	656	656	114	1,269	0	1,269	(499)
2034	0	668	668	116	1,361	0	1,361	(577)
2035	0	680	680	118	1,454	0	1,454	(655)
2036	0	692	692	120	1,546	0	1,546	(733)
2037	0	704	704	122	1,638	0	1,638	(812)
2038	0	717	717	124	1,730	0	1,730	(890)
2039	0	729	729	126	1,822	0	1,822	(968)
2040	0	741	741	128	1,914	0	1,914	(1,046)

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 120 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings (4%) from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	440	440	120	167	0	167	393
2017	0	455	455	123	167	0	167	410
2018	0	470	470	126	201	0	201	395
2019	0	484	484	129	234	0	234	379
2020	0	499	499	132	301	0	301	329
2021	0	511	511	135	371	0	371	275
2022	0	523	523	138	440	0	440	221
2023	0	535	535	141	509	0	509	167
2024	0	547	547	143	578	0	578	113
2025	0	559	559	146	647	0	647	59
2026	0	571	571	149	716	0	716	5
2027	0	583	583	152	785	0	785	(50)
2028	0	596	596	155	854	0	854	(104)
2029	0	608	608	158	924	0	924	(158)
2030	0	620	620	161	993	0	993	(212)
2031	0	632	632	164	1,085	0	1,085	(289)
2032	0	644	644	167	1,177	0	1,177	(366)
2033	0	656	656	170	1,269	0	1,269	(443)
2034	0	668	668	173	1,361	0	1,361	(520)
2035	0	680	680	176	1,454	0	1,454	(597)
2036	0	692	692	179	1,546	0	1,546	(674)
2037	0	704	704	182	1,638	0	1,638	(751)
2038	0	717	717	185	1,730	0	1,730	(829)
2039	0	729	729	188	1,822	0	1,822	(906)
2040	0	741	741	191	1,914	0	1,914	(983)

4. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.
.

Statewide Water Conservation Quantification Project
North Alamo WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares North Alamo WSC's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) North Alamo WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in North Alamo WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for North Alamo WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	95	95	125	0	125	(29)
2016	82	98	180	156	0	156	24
2017	84	100	185	156	0	156	29
2018	86	103	189	187	0	187	2
2019	88	106	194	218	0	218	(24)
2020	90	108	198	280	0	280	(82)
2021	92	111	203	315	0	315	(112)
2022	94	113	207	350	0	350	(143)
2023	96	116	212	384	0	384	(173)
2024	98	119	216	419	0	419	(203)
2025	99	121	221	454	0	454	(233)
2026	101	124	225	489	0	489	(263)
2027	103	126	230	523	0	523	(293)
2028	105	129	234	558	0	558	(324)
2029	107	132	239	593	0	593	(354)
2030	109	134	243	627	0	627	(384)
2031	111	137	248	681	0	681	(434)
2032	113	140	253	736	0	736	(483)
2033	115	142	257	790	0	790	(533)
2034	117	145	262	844	0	844	(582)
2035	119	147	266	898	0	898	(632)
2036	121	150	271	952	0	952	(681)
2037	123	153	275	1,006	0	1,006	(731)
2038	125	155	280	1,060	0	1,060	(780)
2039	127	158	285	1,115	0	1,115	(830)
2040	129	161	289	1,169	0	1,169	(879)
2041	131	163	294	1,241	0	1,241	(947)
2042	133	166	298	1,312	0	1,312	(1,014)
2043	135	168	303	1,384	0	1,384	(1,081)
2044	137	171	308	1,456	0	1,456	(1,148)
2045	139	174	312	1,528	0	1,528	(1,216)
2046	141	176	317	1,600	0	1,600	(1,283)
2047	143	179	322	1,672	0	1,672	(1,350)
2048	145	182	326	1,744	0	1,744	(1,418)
2049	147	184	331	1,816	0	1,816	(1,485)
2050	149	187	336	1,888	0	1,888	(1,552)
2051	151	189	340	1,976	0	1,976	(1,636)
2052	153	192	345	2,064	0	2,064	(1,720)
2053	155	195	350	2,153	0	2,153	(1,803)
2054	157	197	354	2,241	0	2,241	(1,887)
2055	159	200	359	2,330	0	2,330	(1,971)
2056	161	203	364	2,418	0	2,418	(2,055)
2057	163	205	368	2,507	0	2,507	(2,138)
2058	165	208	373	2,595	0	2,595	(2,222)
2059	167	210	378	2,683	0	2,683	(2,306)
2060	169	213	382	2,772	0	2,772	(2,390)
2061	171	216	387	2,873	0	2,873	(2,486)
2062	173	218	391	2,974	0	2,974	(2,582)
2063	175	221	396	3,074	0	3,074	(2,679)
2064	177	223	400	3,175	0	3,175	(2,775)
2065	179	226	405	3,276	0	3,276	(2,871)
2066	181	228	410	3,377	0	3,377	(2,968)
2067	183	231	414	3,478	0	3,478	(3,064)
2068	185	234	419	3,579	0	3,579	(3,160)
2069	187	236	423	3,680	0	3,680	(3,257)
2070	189	239	428	3,781	0	3,781	(3,353)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how North Alamo WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	Baseline	-	160	0	0	0
1	2015	130,308	159	48	95	48
2	2016	133,874	158	98	180	82
3	2017	137,440	157	150	185	34
4	2018	141,006	156	206	189	(17)
5-year Goal	2019	144,572	155	264	194	(70)
6	2020	148,138	154	324	198	(126)
7	2021	151,719	153	388	203	(185)
8	2022	155,299	152	453	207	(246)
9	2023	158,880	151	522	212	(310)
10-year Goal	2024	162,461	150	593	216	(377)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how North Alamo WSC's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	26.00	0	0	0
1	2015	130,308	25.60	19	95	76
2	2016	133,874	25.20	39	98	59
3	2017	137,440	24.80	60	100	40
4	2018	141,006	24.40	82	103	21
5-year Goal	2019	144,572	24.00	106	106	0
6	2020	148,138	23.00	162	108	(54)
7	2021	151,719	22.00	222	111	(111)
8	2022	155,299	21.00	283	113	(170)
9	2023	158,880	20.00	348	116	(232)
10-year Goal	2024	162,461	19.00	415	119	(296)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 95 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 5.5% increase in 2016
    b. Estimated customer demand reduction of 1.1%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014		0
2015		0
2016	82.3	82
2017	84.2	84
2018	86.1	86
2019	88.0	88
2020	89.9	90
2021	91.8	92
2022	93.7	94
2023	95.7	96
2024	97.6	98
2025	99.5	99
2026	101.4	101
2027	103.3	103
2028	105.2	105
2029	107.1	107
2030	109.1	109
2031	111.0	111
2032	113.0	113
2033	114.9	115
2034	116.9	117
2035	118.9	119
2036	120.8	121
2037	122.8	123
2038	124.8	125
2039	126.7	127
2040	128.7	129
2041	130.7	131
2042	132.7	133
2043	134.7	135
2044	136.7	137
2045	138.7	139
2046	140.7	141
2047	142.7	143
2048	144.7	145
2049	146.7	147
2050	148.8	149
2051	150.8	151
2052	152.8	153
2053	154.9	155
2054	156.9	157
2055	159.0	159
2056	161.0	161
2057	163.0	163
2058	165.1	165
2059	167.1	167
2060	169.2	169
2061	171.2	171
2062	173.2	173
2063	175.2	175
2064	177.2	177
2065	179.2	179
2066	181.1	181
2067	183.1	183
2068	185.1	185
2069	187.1	187
2070	189.1	189

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	26.00	0
2015	130,308	24.00	95
2016	133,874	24.00	98
2017	137,440	24.00	100
2018	141,006	24.00	103
2019	144,572	24.00	106
2020	148,138	24.00	108
2021	151,719	24.00	111
2022	155,299	24.00	113
2023	158,880	24.00	116
2024	162,461	24.00	119

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region M savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 378 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	82	98	180	378	156	0	156	402
2017	84	100	185	386	156	0	156	415
2018	86	103	189	395	187	0	187	397
2019	88	106	194	404	218	0	218	380
2020	90	108	198	413	280	0	280	331
2021	92	111	203	422	315	0	315	309
2022	94	113	207	430	350	0	350	288
2023	96	116	212	439	384	0	384	266
2024	98	119	216	448	419	0	419	245
2025	99	121	221	457	454	0	454	224
2026	101	124	225	466	489	0	489	202
2027	103	126	230	474	523	0	523	181
2028	105	129	234	483	558	0	558	159
2029	107	132	239	492	593	0	593	138
2030	109	134	243	501	627	0	627	117
2031	111	137	248	510	681	0	681	76
2032	113	140	253	519	736	0	736	36
2033	115	142	257	528	790	0	790	(5)
2034	117	145	262	537	844	0	844	(45)
2035	119	147	266	546	898	0	898	(86)
2036	121	150	271	555	952	0	952	(127)
2037	123	153	275	564	1,006	0	1,006	(167)
2038	125	155	280	573	1,060	0	1,060	(208)
2039	127	158	285	582	1,115	0	1,115	(248)
2040	129	161	289	591	1,169	0	1,169	(289)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	82	98	180	100	156	0	156	124
2017	84	100	185	103	156	0	156	131
2018	86	103	189	105	187	0	187	107
2019	88	106	194	107	218	0	218	83
2020	90	108	198	110	280	0	280	27
2021	92	111	203	112	315	0	315	(1)
2022	94	113	207	114	350	0	350	(28)
2023	96	116	212	117	384	0	384	(56)
2024	98	119	216	119	419	0	419	(84)
2025	99	121	221	121	454	0	454	(112)
2026	101	124	225	124	489	0	489	(140)
2027	103	126	230	126	523	0	523	(168)
2028	105	129	234	128	558	0	558	(195)
2029	107	132	239	131	593	0	593	(223)
2030	109	134	243	133	627	0	627	(251)
2031	111	137	248	135	681	0	681	(298)
2032	113	140	253	138	736	0	736	(345)
2033	115	142	257	140	790	0	790	(393)
2034	117	145	262	142	844	0	844	(440)
2035	119	147	266	145	898	0	898	(487)
2036	121	150	271	147	952	0	952	(534)
2037	123	153	275	150	1,006	0	1,006	(581)
2038	125	155	280	152	1,060	0	1,060	(628)
2039	127	158	285	154	1,115	0	1,115	(676)
2040	129	161	289	157	1,169	0	1,169	(723)

3. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Olmito WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Olmito WSC's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Olmito WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Olmito WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Olmito WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	10.2	10	3	0	3	7
2016	0	9.6	10	4	0	4	6
2017	0	9.0	9	4	0	4	5
2018	0	8.4	8	5	0	5	4
2019	0	7.8	8	6	0	6	2
2020	0	7.2	7	7	0	7	0
2021	0	7.4	7	9	0	9	(2)
2022	0	7.5	7	11	0	11	(4)
2023	0	7.6	8	13	0	13	(6)
2024	0	7.7	8	15	0	15	(8)
2025	0	7.8	8	17	0	17	(10)
2026	0	8.0	8	19	0	19	(12)
2027	0	8.1	8	22	0	22	(13)
2028	0	8.2	8	24	0	24	(15)
2029	0	8.3	8	26	0	26	(17)
2030	0	8.4	8	28	0	28	(19)
2031	0	8.6	9	29	0	29	(21)
2032	0	8.7	9	31	0	31	(23)
2033	0	8.8	9	33	0	33	(24)
2034	0	8.9	9	35	0	35	(26)
2035	0	9.1	9	37	0	37	(28)
2036	0	9.2	9	38	0	38	(29)
2037	0	9.3	9	40	0	40	(31)
2038	0	9.4	9	42	0	42	(33)
2039	0	9.6	10	44	0	44	(34)
2040	0	9.7	10	46	0	46	(36)
2041	0	9.8	10	47	0	47	(38)
2042	0	10.0	10	49	0	49	(39)
2043	0	10.1	10	51	0	51	(41)
2044	0	10.2	10	53	0	53	(43)
2045	0	10.4	10	55	0	55	(44)
2046	0	10.5	10	57	0	57	(46)
2047	0	10.6	11	58	0	58	(48)
2048	0	10.7	11	60	0	60	(49)
2049	0	10.9	11	62	0	62	(51)
2050	0	11.0	11	64	0	64	(53)
2051	0	11.2	11	66	0	66	(55)
2052	0	11.3	11	68	0	68	(57)
2053	0	11.4	11	71	0	71	(59)
2054	0	11.6	12	73	0	73	(61)
2055	0	11.7	12	75	0	75	(63)
2056	0	11.8	12	77	0	77	(66)
2057	0	12.0	12	80	0	80	(68)
2058	0	12.1	12	82	0	82	(70)
2059	0	12.2	12	84	0	84	(72)
2060	0	12.4	12	86	0	86	(74)
2061	0	12.5	13	89	0	89	(76)
2062	0	12.7	13	92	0	92	(79)
2063	0	12.8	13	94	0	94	(81)
2064	0	12.9	13	97	0	97	(84)
2065	0	13.1	13	100	0	100	(86)
2066	0	13.2	13	102	0	102	(89)
2067	0	13.4	13	105	0	105	(91)
2068	0	13.5	14	107	0	107	(94)
2069	0	13.6	14	110	0	110	(96)
2070	0	13.8	14	113	0	113	(99)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Olmito WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	161	0	0	0
1	2015	5,600	158	5	10	5
2	2016	5,273	156	10	10	(0)
3	2017	4,945	153	14	9	(5)
4	2018	4,618	151	18	8	(9)
5-year Goal	2019	4,290	148	20	8	(13)
6	2020	3,963	148	19	7	(12)
7	2021	4,030	147	20	7	(13)
8	2022	4,096	147	21	7	(14)
9	2023	4,163	146	22	8	(15)
10-year Goal	2024	4,230	146	23	8	(15)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Olmito WSC's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	21.00	0	0	0
1	2015	5,600	18.20	6	10.2	4
2	2016	5,273	15.40	11	9.6	(1)
3	2017	4,945	12.60	15	9.0	(6)
4	2018	4,618	9.80	19	8.4	(10)
5-year Goal	2019	4,290	7.00	22	7.8	(14)
6	2020	3,963	6.80	21	7.2	(13)
7	2021	4,030	6.60	21	7.4	(14)
8	2022	4,096	6.40	22	7.5	(14)
9	2023	4,163	6.20	22	7.6	(15)
10-year Goal	2024	4,230	6.00	23	7.7	(15)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 10.2 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	21.00	0
2015	5,600	16.00	10
2016	5,273	16.00	10
2017	4,945	16.00	9
2018	4,618	16.00	8
2019	4,290	16.00	8
2020	3,963	16.00	7
2021	4,030	16.00	7
2022	4,096	16.00	7
2023	4,163	16.00	8
2024	4,230	16.00	8

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region M savings
ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 11 MG per year with current demand.
c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	10	10	11	4	0	4	17
2017	0	9	9	12	4	0	4	17
2018	0	8	8	12	5	0	5	15
2019	0	8	8	12	6	0	6	14
2020	0	7	7	12	7	0	7	12
2021	0	7	7	12	9	0	9	10
2022	0	7	7	12	11	0	11	9
2023	0	8	8	13	13	0	13	7
2024	0	8	8	13	15	0	15	5
2025	0	8	8	13	17	0	17	3
2026	0	8	8	13	19	0	19	2
2027	0	8	8	13	22	0	22	(0)
2028	0	8	8	13	24	0	24	(2)
2029	0	8	8	14	26	0	26	(4)
2030	0	8	8	14	28	0	28	(6)
2031	0	9	9	14	29	0	29	(7)
2032	0	9	9	14	31	0	31	(8)
2033	0	9	9	14	33	0	33	(10)
2034	0	9	9	14	35	0	35	(11)
2035	0	9	9	15	37	0	37	(13)
2036	0	9	9	15	38	0	38	(14)
2037	0	9	9	15	40	0	40	(16)
2038	0	9	9	15	42	0	42	(17)
2039	0	10	10	15	44	0	44	(19)
2040	0	10	10	15	46	0	46	(20)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal

i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

i. This was the most common percentage of residential use among participating utilities in this project.

ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

g. See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	10	10	3	4	0	4	9
2017	0	9	9	3	4	0	4	8
2018	0	8	8	3	5	0	5	7
2019	0	8	8	3	6	0	6	5
2020	0	7	7	3	7	0	7	3
2021	0	7	7	3	9	0	9	1
2022	0	7	7	3	11	0	11	(1)
2023	0	8	8	3	13	0	13	(2)
2024	0	8	8	3	15	0	15	(4)
2025	0	8	8	3	17	0	17	(6)
2026	0	8	8	3	19	0	19	(8)
2027	0	8	8	4	22	0	22	(10)
2028	0	8	8	4	24	0	24	(12)
2029	0	8	8	4	26	0	26	(14)
2030	0	8	8	4	28	0	28	(16)
2031	0	9	9	4	29	0	29	(17)
2032	0	9	9	4	31	0	31	(19)
2033	0	9	9	4	33	0	33	(20)
2034	0	9	9	4	35	0	35	(22)
2035	0	9	9	4	37	0	37	(24)
2036	0	9	9	4	38	0	38	(25)
2037	0	9	9	4	40	0	40	(27)
2038	0	9	9	4	42	0	42	(29)
2039	0	10	10	4	44	0	44	(30)
2040	0	10	10	4	46	0	46	(32)

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

3. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 5 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	10	10	5	4	0	4	10
2017	0	9	9	5	4	0	4	10
2018	0	8	8	5	5	0	5	8
2019	0	8	8	5	6	0	6	7
2020	0	7	7	5	7	0	7	5
2021	0	7	7	5	9	0	9	3
2022	0	7	7	5	11	0	11	1
2023	0	8	8	5	13	0	13	(1)
2024	0	8	8	5	15	0	15	(3)
2025	0	8	8	5	17	0	17	(4)
2026	0	8	8	5	19	0	19	(6)
2027	0	8	8	5	22	0	22	(8)
2028	0	8	8	5	24	0	24	(10)
2029	0	8	8	5	26	0	26	(12)
2030	0	8	8	5	28	0	28	(14)
2031	0	9	9	6	29	0	29	(15)
2032	0	9	9	6	31	0	31	(17)
2033	0	9	9	6	33	0	33	(19)
2034	0	9	9	6	35	0	35	(20)
2035	0	9	9	6	37	0	37	(22)
2036	0	9	9	6	38	0	38	(23)
2037	0	9	9	6	40	0	40	(25)
2038	0	9	9	6	42	0	42	(27)
2039	0	10	10	6	44	0	44	(28)
2040	0	10	10	6	46	0	46	(30)

4. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Statewide Water Conservation Quantification Project
City of Pharr Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Pharr's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Pharr's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Pharr's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Pharr with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	28	28	0	0	0	28
2016	0	29	29	0	0	0	29
2017	0	30	30	0	0	0	30
2018	0	31	31	0	0	0	31
2019	0	32	32	0	0	0	32
2020	0	33	33	0	0	0	33
2021	0	33	33	0	0	0	33
2022	0	34	34	0	0	0	34
2023	0	35	35	0	0	0	35
2024	0	36	36	0	0	0	36
2025	0	37	37	0	0	0	37
2026	0	37	37	0	0	0	37
2027	0	38	38	0	0	0	38
2028	0	39	39	0	0	0	39
2029	0	40	40	0	0	0	40
2030	0	40	40	0	0	0	40
2031	0	41	41	5	0	5	36
2032	0	42	42	11	0	11	31
2033	0	43	43	16	0	16	26
2034	0	44	44	22	0	22	22
2035	0	44	44	27	0	27	17
2036	0	45	45	33	0	33	13
2037	0	46	46	38	0	38	8
2038	0	47	47	44	0	44	3
2039	0	48	48	49	0	49	(1)
2040	0	48	48	54	0	54	(6)
2041	0	49	49	77	0	77	(27)
2042	0	50	50	99	0	99	(49)
2043	0	51	51	121	0	121	(70)
2044	0	52	52	143	0	143	(92)
2045	0	52	52	165	0	165	(113)
2046	0	53	53	188	0	188	(134)
2047	0	54	54	210	0	210	(156)
2048	0	55	55	232	0	232	(177)
2049	0	55	55	254	0	254	(199)
2050	0	56	56	276	0	276	(220)
2051	0	57	57	307	0	307	(250)
2052	0	58	58	337	0	337	(279)
2053	0	59	59	367	0	367	(309)
2054	0	59	59	397	0	397	(338)
2055	0	60	60	428	0	428	(368)
2056	0	61	61	458	0	458	(397)
2057	0	62	62	488	0	488	(426)
2058	0	63	63	519	0	519	(456)
2059	0	63	63	549	0	549	(485)
2060	0	64	64	579	0	579	(515)
2061	0	65	65	615	0	615	(550)
2062	0	66	66	651	0	651	(586)
2063	0	66	66	687	0	687	(621)
2064	0	67	67	723	0	723	(656)
2065	0	68	68	760	0	760	(691)
2066	0	69	69	796	0	796	(727)
2067	0	70	70	832	0	832	(762)
2068	0	70	70	868	0	868	(797)
2069	0	71	71	904	0	904	(833)
2070	0	72	72	940	0	940	(868)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Pharr's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	95	0	0	0
1	2015	76,538	99	(112)	28	140
2	2016	79,074	103	(231)	29	260
3	2017	81,611	107	(357)	30	387
4	2018	84,147	111	(491)	31	522
5-year Goal	2019	86,684	115	(633)	32	664
6	2020	89,220	112	(554)	33	586
7	2021	91,377	109	(467)	33	500
8	2022	93,533	106	(376)	34	410
9	2023	95,690	103	(279)	35	314
10-year Goal	2024	97,846	100	(179)	36	214

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Pharr's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	7.00	0	0	0
1	2015	76,538	7.80	(22)	28	50
2	2016	79,074	8.60	(46)	29	75
3	2017	81,611	9.40	(71)	30	101
4	2018	84,147	10.20	(98)	31	129
5-year Goal	2019	86,684	11.00	(127)	32	158
6	2020	89,220	10.40	(111)	33	143
7	2021	91,377	9.80	(93)	33	127
8	2022	93,533	9.20	(75)	34	109
9	2023	95,690	8.60	(56)	35	91
10-year Goal	2024	97,846	8.00	(36)	36	71

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 28 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	7.00	0
2015	76,538	6.00	28
2016	79,074	6.00	29
2017	81,611	6.00	30
2018	84,147	6.00	31
2019	86,684	6.00	32
2020	89,220	6.00	33
2021	91,377	6.00	33
2022	93,533	6.00	34
2023	95,690	6.00	35
2024	97,846	6.00	36

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.

- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[17]

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	29	29	40	0	0	0	69
2017	0	30	30	41	0	0	0	70
2018	0	31	31	42	0	0	0	72
2019	0	32	32	42	0	0	0	74
2020	0	33	33	43	0	0	0	76
2021	0	33	33	44	0	0	0	78
2022	0	34	34	45	0	0	0	79
2023	0	35	35	46	0	0	0	81
2024	0	36	36	47	0	0	0	83
2025	0	37	37	48	0	0	0	84
2026	0	37	37	49	0	0	0	86
2027	0	38	38	49	0	0	0	88
2028	0	39	39	50	0	0	0	89
2029	0	40	40	51	0	0	0	91
2030	0	40	40	52	0	0	0	93
2031	0	41	41	53	5	0	5	89
2032	0	42	42	54	11	0	11	85
2033	0	43	43	55	16	0	16	81
2034	0	44	44	56	22	0	22	78
2035	0	44	44	57	27	0	27	74
2036	0	45	45	58	33	0	33	70
2037	0	46	46	58	38	0	38	66
2038	0	47	47	59	44	0	44	63
2039	0	48	48	60	49	0	49	59
2040	0	48	48	61	54	0	54	55

2. Rain Barrels

a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).

b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of San Juan Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

> after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares San Juan's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) San Juan's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in San Juan's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for San Juan with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	17.9	(95)	(77)	0	0	0	(77)
2016	18.4	(98)	(79)	0	0	0	(79)
2017	18.8	(101)	(82)	0	0	0	(82)
2018	19.2	(104)	(84)	0	0	0	(84)
2019	19.6	(107)	(87)	0	0	0	(87)
2020	20.0	(110)	(90)	0	0	0	(90)
2021	20.5	(112)	(92)	0	0	0	(92)
2022	20.9	(115)	(94)	1	0	1	(95)
2023	21.3	(118)	(96)	1	0	1	(98)
2024	21.7	(120)	(98)	2	0	2	(100)
2025	22.2	(123)	(101)	2	0	2	(103)
2026	22.6	(126)	(103)	3	0	3	(106)
2027	23.0	(128)	(105)	3	0	3	(109)
2028	23.4	(131)	(107)	4	0	4	(111)
2029	23.9	(133)	(110)	4	0	4	(114)
2030	24.3	(136)	(112)	5	0	5	(117)
2031	24.7	(139)	(114)	15	0	15	(129)
2032	25.1	(141)	(116)	25	0	25	(142)
2033	25.6	(144)	(119)	36	0	36	(154)
2034	26.0	(147)	(121)	46	0	46	(167)
2035	26.4	(149)	(123)	56	0	56	(179)
2036	26.9	(152)	(125)	66	0	66	(192)
2037	27.3	(155)	(127)	77	0	77	(204)
2038	27.8	(157)	(130)	87	0	87	(217)
2039	28.2	(160)	(132)	97	0	97	(229)
2040	28.6	(163)	(134)	108	0	108	(242)
2041	29.1	(165)	(136)	123	0	123	(259)
2042	29.5	(168)	(139)	138	0	138	(277)
2043	30.0	(171)	(141)	153	0	153	(294)
2044	30.4	(173)	(143)	169	0	169	(312)
2045	30.9	(176)	(145)	184	0	184	(329)
2046	31.3	(179)	(147)	199	0	199	(347)
2047	31.8	(181)	(150)	215	0	215	(364)
2048	32.2	(184)	(152)	230	0	230	(382)
2049	32.6	(187)	(154)	245	0	245	(399)
2050	33.1	(189)	(156)	260	0	260	(417)
2051	33.6	(192)	(158)	280	0	280	(439)
2052	34.0	(195)	(161)	300	0	300	(461)
2053	34.5	(197)	(163)	320	0	320	(483)
2054	34.9	(200)	(165)	340	0	340	(505)
2055	35.4	(203)	(167)	360	0	360	(527)
2056	35.8	(205)	(170)	380	0	380	(550)
2057	36.3	(208)	(172)	400	0	400	(572)
2058	36.8	(211)	(174)	420	0	420	(594)
2059	37.2	(213)	(176)	440	0	440	(616)
2060	37.7	(216)	(178)	460	0	460	(638)
2061	38.1	(219)	(181)	483	0	483	(664)
2062	38.6	(221)	(183)	507	0	507	(689)
2063	39.0	(224)	(185)	530	0	530	(715)
2064	39.5	(226)	(187)	553	0	553	(740)
2065	39.9	(229)	(189)	577	0	577	(766)
2066	40.4	(232)	(191)	600	0	600	(791)
2067	40.8	(234)	(193)	623	0	623	(817)
2068	41.3	(237)	(196)	647	0	647	(842)
2069	41.7	(239)	(198)	670	0	670	(868)
2070	42.2	(242)	(200)	694	0	694	(893)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how San Juan's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	82	0	0	0
1	2015	37,000	81	8	(77)	(85)
2	2016	38,181	81	17	(79)	(96)
3	2017	39,362	80	26	(82)	(108)
4	2018	40,544	80	36	(84)	(120)
5-year Goal	2019	41,725	79	46	(87)	(133)
6	2020	42,906	78	60	(90)	(149)
7	2021	43,943	77	74	(92)	(166)
8	2022	44,980	77	89	(94)	(183)
9	2023	46,017	76	104	(96)	(200)
10-year Goal	2024	47,054	75	120	(98)	(219)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how San Juan's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	14	0	0	0
1	2015	37,000	12	26	(95)	(121)
2	2016	38,181	10.1	55	(98)	(152)
3	2017	39,362	8.1	84	(101)	(185)
4	2018	40,544	6.2	116	(104)	(220)
5-year Goal	2019	41,725	4.2	149	(107)	(256)
6	2020	42,906	4.2	153	(110)	(263)
7	2021	43,943	4.2	157	(112)	(269)
8	2022	44,980	4.2	161	(115)	(276)
9	2023	46,017	4.2	165	(118)	(282)
10-year Goal	2024	47,054	4.2	168	(120)	(289)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 95 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases..

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	TOTAL SAVINGS
2009	15.4	15.4
2010	15.8	15.8
2011	16.3	16.3
2012	16.7	16.7
2013	17.1	17.1
2014	17.5	17.5
2015	17.9	17.9
2016	18.4	18.4
2017	18.8	18.8
2018	19.2	19.2
2019	19.6	19.6
2020	20.0	20.0
2021	20.5	20.5
2022	20.9	20.9
2023	21.3	21.3
2024	21.7	21.7
2025	22.2	22.2
2026	22.6	22.6
2027	23.0	23.0
2028	23.4	23.4
2029	23.9	23.9
2030	24.3	24.3
2031	24.7	24.7
2032	25.1	25.1
2033	25.6	25.6
2034	26.0	26.0
2035	26.4	26.4
2036	26.9	26.9
2037	27.3	27.3
2038	27.8	27.8
2039	28.2	28.2
2040	28.6	28.6
2041	29.1	29.1
2042	29.5	29.5
2043	30.0	30.0
2044	30.4	30.4
2045	30.9	30.9
2046	31.3	31.3
2047	31.8	31.8
2048	32.2	32.2
2049	32.6	32.6
2050	33.1	33.1
2051	33.6	33.6
2052	34.0	34.0
2053	34.5	34.5
2054	34.9	34.9
2055	35.4	35.4
2056	35.8	35.8
2057	36.3	36.3
2058	36.8	36.8
2059	37.2	37.2
2060	37.7	37.7
2061	38.1	38.1
2062	38.6	38.6
2063	39.0	39.0
2064	39.5	39.5
2065	39.9	39.9
2066	40.4	40.4
2067	40.8	40.8
2068	41.3	41.3
2069	41.7	41.7
2070	42.2	42.2

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	14	0
2015	37,000	21	(95)
2016	38,181	21	(98)
2017	39,362	21	(101)
2018	40,544	21	(104)
2019	41,725	21	(107)
2020	42,906	21	(110)
2021	43,943	21	(112)
2022	44,980	21	(115)
2023	46,017	21	(118)
2024	47,054	21	(120)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 93 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	18	(98)	(79)	93	0	0	0	14
2017	19	(101)	(82)	95	0	0	0	13
2018	19	(104)	(84)	97	0	0	0	13
2019	20	(107)	(87)	99	0	0	0	12
2020	20	(110)	(90)	101	0	0	0	12
2021	20	(112)	(92)	103	0	0	0	11
2022	21	(115)	(94)	106	1	0	1	11
2023	21	(118)	(96)	108	1	0	1	10
2024	22	(120)	(98)	110	2	0	2	9
2025	22	(123)	(101)	112	2	0	2	9
2026	23	(126)	(103)	114	3	0	3	8
2027	23	(128)	(105)	116	3	0	3	8
2028	23	(131)	(107)	118	4	0	4	7
2029	24	(133)	(110)	120	4	0	4	6
2030	24	(136)	(112)	123	5	0	5	6
2031	25	(139)	(114)	125	15	0	15	(4)
2032	25	(141)	(116)	127	25	0	25	(15)
2033	26	(144)	(119)	129	36	0	36	(25)
2034	26	(147)	(121)	131	46	0	46	(35)
2035	26	(149)	(123)	134	56	0	56	(46)
2036	27	(152)	(125)	136	66	0	66	(56)
2037	27	(155)	(127)	138	77	0	77	(66)
2038	28	(157)	(130)	140	87	0	87	(77)
2039	28	(160)	(132)	142	97	0	97	(87)
2040	29	(163)	(134)	145	108	0	108	(97)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[18]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	18	(98)	(79)	25	0	0	0	(55)
2017	19	(101)	(82)	25	0	0	0	(57)
2018	19	(104)	(84)	26	0	0	0	(59)
2019	20	(107)	(87)	26	0	0	0	(61)
2020	20	(110)	(90)	27	0	0	0	(63)
2021	20	(112)	(92)	27	0	0	0	(65)
2022	21	(115)	(94)	28	1	0	1	(67)
2023	21	(118)	(96)	29	1	0	1	(69)
2024	22	(120)	(98)	29	2	0	2	(71)
2025	22	(123)	(101)	30	2	0	2	(73)
2026	23	(126)	(103)	30	3	0	3	(76)
2027	23	(128)	(105)	31	3	0	3	(78)
2028	23	(131)	(107)	31	4	0	4	(80)
2029	24	(133)	(110)	32	4	0	4	(82)
2030	24	(136)	(112)	33	5	0	5	(84)
2031	25	(139)	(114)	33	15	0	15	(96)
2032	25	(141)	(116)	34	25	0	25	(108)
2033	26	(144)	(119)	34	36	0	36	(120)
2034	26	(147)	(121)	35	46	0	46	(132)
2035	26	(149)	(123)	35	56	0	56	(144)
2036	27	(152)	(125)	36	66	0	66	(156)
2037	27	(155)	(127)	37	77	0	77	(168)
2038	28	(157)	(130)	37	87	0	87	(179)
2039	28	(160)	(132)	38	97	0	97	(191)
2040	29	(163)	(134)	38	108	0	108	(203)

3. Water Rate Increase
   a. For every 10% increase, estimated savings could be 2% of utility total demand.
   b. Approximately 37 MG of savings per year with current demand
   c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
   d. See Table 6-3 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases..

Table 6-3. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	18	(98)	(79)	37	0	0	0	(42)
2017	19	(101)	(82)	38	0	0	0	(44)
2018	19	(104)	(84)	38	0	0	0	(46)
2019	20	(107)	(87)	39	0	0	0	(48)
2020	20	(110)	(90)	40	0	0	0	(49)
2021	20	(112)	(92)	41	0	0	0	(51)
2022	21	(115)	(94)	42	1	0	1	(53)
2023	21	(118)	(96)	43	1	0	1	(55)
2024	22	(120)	(98)	43	2	0	2	(57)
2025	22	(123)	(101)	44	2	0	2	(59)
2026	23	(126)	(103)	45	3	0	3	(61)
2027	23	(128)	(105)	46	3	0	3	(63)
2028	23	(131)	(107)	47	4	0	4	(64)
2029	24	(133)	(110)	48	4	0	4	(66)
2030	24	(136)	(112)	49	5	0	5	(68)
2031	25	(139)	(114)	49	15	0	15	(80)
2032	25	(141)	(116)	50	25	0	25	(91)
2033	26	(144)	(119)	51	36	0	36	(103)
2034	26	(147)	(121)	52	46	0	46	(115)
2035	26	(149)	(123)	53	56	0	56	(126)
2036	27	(152)	(125)	54	66	0	66	(138)
2037	27	(155)	(127)	55	77	0	77	(150)
2038	28	(157)	(130)	56	87	0	87	(161)
2039	28	(160)	(132)	56	97	0	97	(173)
2040	29	(163)	(134)	57	108	0	108	(184)

4. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Sharyland WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were to be completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2015j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Sharyland WSC's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Sharyland WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Sharyland WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Sharyland WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	50	85	135	33	0	33	102
2016	51	86	137	42	0	42	95
2017	52	87	139	42	0	42	97
2018	53	88	141	50	0	50	91
2019	54	89	143	59	0	59	84
2020	55	89	145	75	0	75	70
2021	57	90	147	99	0	99	47
2022	58	91	148	123	0	123	25
2023	59	91	150	147	0	147	3
2024	60	92	152	171	0	171	(19)
2025	61	93	154	195	0	195	(42)
2026	62	93	156	219	0	219	(64)
2027	64	94	157	243	0	243	(86)
2028	65	94	159	267	0	267	(108)
2029	66	95	161	291	0	291	(130)
2030	67	96	163	315	0	315	(153)
2031	68	96	165	333	0	333	(168)
2032	70	97	167	351	0	351	(184)
2033	71	98	168	368	0	368	(200)
2034	72	98	170	386	0	386	(216)
2035	73	99	172	403	0	403	(231)
2036	74	99	174	421	0	421	(247)
2037	76	100	176	438	0	438	(263)
2038	77	101	178	456	0	456	(278)
2039	78	101	179	474	0	474	(294)
2040	79	102	181	491	0	491	(310)
2041	80	103	183	515	0	515	(332)
2042	82	103	185	539	0	539	(354)
2043	83	104	187	562	0	562	(376)
2044	84	104	189	586	0	586	(397)
2045	85	105	190	610	0	610	(419)
2046	87	106	192	633	0	633	(441)
2047	88	106	194	657	0	657	(463)
2048	89	107	196	681	0	681	(485)
2049	90	108	198	705	0	705	(507)
2050	92	108	200	728	0	728	(529)
2051	93	110	203	758	0	758	(555)
2052	94	113	207	787	0	787	(581)
2053	95	115	210	817	0	817	(607)
2054	97	117	213	846	0	846	(633)
2055	98	119	217	876	0	876	(659)
2056	99	121	220	906	0	906	(685)
2057	100	123	224	935	0	935	(711)
2058	102	125	227	965	0	965	(737)
2059	103	128	231	994	0	994	(764)
2060	104	130	234	1,024	0	1,024	(790)
2061	106	131	237	1,057	0	1,057	(820)
2062	107	133	240	1,090	0	1,090	(851)
2063	108	134	242	1,124	0	1,124	(881)
2064	109	136	245	1,157	0	1,157	(912)
2065	111	137	248	1,190	0	1,190	(942)
2066	112	139	251	1,224	0	1,224	(973)
2067	113	141	254	1,257	0	1,257	(1,003)
2068	114	142	256	1,290	0	1,290	(1,034)
2069	115	144	259	1,324	0	1,324	(1,065)
2070	117	145	262	1,357	0	1,357	(1,095)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Sharyland WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match five- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	154	0	0	0
1	2015	58,500	153	30	135	105
2	2016	59,048	151	60	137	77
3	2017	59,596	150	91	139	48
4	2018	60,144	148	123	141	18
5-year Goal	2019	60,692	147	155	143	(12)
6	2020	61,240	146	183	145	(38)
7	2021	61,671	145	212	147	(65)
8	2022	62,101	143	240	148	(92)
9	2023	62,532	142	269	150	(119)
10-year Goal	2024	62,962	141	299	152	(147)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Sharyland WSC's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	58,500	10.00	0	85	85
2	2016	59,048	10.00	0	86	86
3	2017	59,596	10.00	0	87	87
4	2018	60,144	10.00	0	88	88
5-year Goal	2019	60,692	10.00	0	89	89
6	2020	61,240	9.00	22	89	67
7	2021	61,671	8.00	45	90	45
8	2022	62,101	7.00	68	91	23
9	2023	62,532	6.00	91	91	0
10-year Goal	2024	62,962	5.00	115	92	(23)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 85 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 10.6% increase in 2014
    b. Estimated customer demand reduction of 2.2%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014	48.4	48
2015	49.6	50
2016	50.8	51
2017	51.9	52
2018	53.1	53
2019	54.3	54
2020	55.5	55
2021	56.6	57
2022	57.8	58
2023	59.0	59
2024	60.1	60
2025	61.3	61
2026	62.5	62
2027	63.7	64
2028	64.8	65
2029	66.0	66
2030	67.2	67
2031	68.4	68
2032	69.6	70
2033	70.8	71
2034	72.0	72
2035	73.2	73
2036	74.4	74
2037	75.6	76
2038	76.8	77
2039	78.0	78
2040	79.2	79
2041	80.4	80
2042	81.7	82
2043	82.9	83
2044	84.1	84
2045	85.4	85
2046	86.6	87
2047	87.8	88
2048	89.1	89
2049	90.3	90
2050	91.6	92
2051	92.8	93
2052	94.1	94
2053	95.4	95
2054	96.6	97
2055	97.9	98
2056	99.2	99
2057	100.5	100
2058	101.7	102
2059	103.0	103
2060	104.3	104
2061	105.5	106
2062	106.8	107
2063	108.0	108
2064	109.3	109
2065	110.5	111
2066	111.8	112
2067	113.0	113
2068	114.2	114
2069	115.5	115
2070	116.7	117

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	58,500	6.00	85
2016	59,048	6.00	86
2017	59,596	6.00	87
2018	60,144	6.00	88
2019	60,692	6.00	89
2020	61,240	6.00	89
2021	61,671	6.00	90
2022	62,101	6.00	91
2023	62,532	6.00	91
2024	62,962	6.00	92

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 121 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	51	86	137	121	42	0	42	216
2017	52	87	139	124	42	0	42	221
2018	53	88	141	127	50	0	50	217
2019	54	89	143	129	59	0	59	214
2020	55	89	145	132	75	0	75	202
2021	57	90	147	135	99	0	99	182
2022	58	91	148	138	123	0	123	163
2023	59	91	150	140	147	0	147	143
2024	60	92	152	143	171	0	171	124
2025	61	93	154	146	195	0	195	105
2026	62	93	156	149	219	0	219	85
2027	64	94	157	152	243	0	243	66
2028	65	94	159	154	267	0	267	46
2029	66	95	161	157	291	0	291	27
2030	67	96	163	160	315	0	315	7
2031	68	96	165	163	333	0	333	(5)
2032	70	97	167	166	351	0	351	(18)
2033	71	98	168	169	368	0	368	(31)
2034	72	98	170	171	386	0	386	(44)
2035	73	99	172	174	403	0	403	(57)
2036	74	99	174	177	421	0	421	(70)
2037	76	100	176	180	438	0	438	(83)
2038	77	101	178	183	456	0	456	(96)
2039	78	101	179	186	474	0	474	(108)
2040	79	102	181	189	491	0	491	(121)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	51	86	137	32	42	0	42	127
2017	52	87	139	33	42	0	42	130
2018	53	88	141	34	50	0	50	124
2019	54	89	143	34	59	0	59	119
2020	55	89	145	35	75	0	75	105
2021	57	90	147	36	99	0	99	83
2022	58	91	148	37	123	0	123	62
2023	59	91	150	37	147	0	147	40
2024	60	92	152	38	171	0	171	19
2025	61	93	154	39	195	0	195	(3)
2026	62	93	156	39	219	0	219	(24)
2027	64	94	157	40	243	0	243	(46)
2028	65	94	159	41	267	0	267	(67)
2029	66	95	161	42	291	0	291	(89)
2030	67	96	163	42	315	0	315	(110)
2031	68	96	165	43	333	0	333	(125)
2032	70	97	167	44	351	0	351	(140)
2033	71	98	168	45	368	0	368	(155)
2034	72	98	170	45	386	0	386	(170)
2035	73	99	172	46	403	0	403	(185)
2036	74	99	174	47	421	0	421	(200)
2037	76	100	176	48	438	0	438	(215)
2038	77	101	178	49	456	0	456	(230)
2039	78	101	179	49	474	0	474	(245)
2040	79	102	181	50	491	0	491	(260)

3. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Union WSC Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Union WSC's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Union WSC's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Union WSC's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Union WSC with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	13	(14)	(1)	0	0	0	(1)
2016	13	(14)	(1)	0	0	0	(1)
2017	13	(14)	0	0	0	0	0
2018	13	(14)	0	0	0	0	0
2019	13	(14)	0	0	0	0	0
2020	13	(14)	0	0	0	0	0
2021	14	(14)	0	0	0	0	0
2022	14	(14)	0	0	0	0	0
2023	14	(14)	0	0	0	0	0
2024	14	(14)	0	0	0	0	0
2025	14	(14)	0	0	0	0	0
2026	14	(15)	0	0	0	0	0
2027	14	(15)	0	0	0	0	0
2028	15	(15)	0	0	0	0	0
2029	15	(15)	0	0	0	0	0
2030	15	(15)	0	0	0	0	0
2031	15	(15)	0	1	0	1	(1)
2032	15	(16)	0	2	0	2	(2)
2033	15	(16)	0	2	0	2	(3)
2034	15	(16)	(1)	3	0	3	(4)
2035	15	(16)	(1)	4	0	4	(5)
2036	16	(16)	(1)	5	0	5	(5)
2037	16	(16)	(1)	6	0	6	(6)
2038	16	(17)	(1)	7	0	7	(7)
2039	16	(17)	(1)	7	0	7	(8)
2040	16	(17)	(1)	8	0	8	(9)
2041	16	(17)	(1)	10	0	10	(10)
2042	16	(17)	(1)	11	0	11	(12)
2043	17	(17)	(1)	13	0	13	(13)
2044	17	(17)	(1)	14	0	14	(15)
2045	17	(18)	(1)	15	0	15	(16)
2046	17	(18)	(1)	17	0	17	(18)
2047	17	(18)	(1)	18	0	18	(19)
2048	17	(18)	(1)	20	0	20	(21)
2049	17	(18)	(1)	21	0	21	(22)
2050	18	(18)	(1)	23	0	23	(24)
2051	18	(19)	(1)	25	0	25	(26)
2052	18	(19)	(1)	26	0	26	(27)
2053	18	(19)	(1)	28	0	28	(29)
2054	18	(19)	(1)	30	0	30	(31)
2055	18	(19)	(1)	32	0	32	(33)
2056	18	(19)	(1)	33	0	33	(34)
2057	18	(19)	(1)	35	0	35	(36)
2058	19	(20)	(1)	37	0	37	(38)
2059	19	(20)	(1)	39	0	39	(40)
2060	19	(20)	(1)	40	0	40	(41)
2061	19	(20)	(1)	42	0	42	(43)
2062	19	(20)	(1)	44	0	44	(45)
2063	19	(20)	(1)	46	0	46	(47)
2064	19	(20)	(1)	48	0	48	(49)
2065	19	(21)	(1)	50	0	50	(51)
2066	20	(21)	(1)	52	0	52	(53)
2067	20	(21)	(1)	54	0	54	(55)
2068	20	(21)	(1)	56	0	56	(57)
2069	20	(21)	(1)	58	0	58	(59)
2070	20	(21)	(1)	60	0	60	(61)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Union WSC's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	94	0	0	0
1	2014	7,423	96	(6)	13	19
2	2015	7,428	98	(12)	(1)	11
3	2016	7,434	101	(18)	(1)	17
4	2017	7,439	103	(24)	0	23
5-year Goal	2018	7,445	105	(30)	0	30
6	2019	7,450	104	(27)	0	27
7	2020	7,539	103	(25)	0	25
8	2021	7,628	102	(22)	0	22
9	2022	7,718	101	(20)	0	20
10-year Goal	2023	7,807	100	(17)	0	17

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Union WSC's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	38.00	0	0	0
1	2014	7,423	37.60	1	(14)	(15)
2	2015	7,428	37.20	2	(14)	(16)
3	2016	7,434	36.80	3	(14)	(17)
4	2017	7,439	36.40	4	(14)	(18)
5-year Goal	2018	7,445	36.00	5	(14)	(19)
6	2019	7,450	33.60	12	(14)	(26)
7	2020	7,539	31.20	19	(14)	(32)
8	2021	7,628	28.80	26	(14)	(40)
9	2022	7,718	26.40	33	(14)	(47)
10-year Goal	2023	7,807	24.00	40	(14)	(54)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 14 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 25% increase in 2014
    b. Estimated customer demand reduction of 5.0%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0.0
2010		0.0
2011		0.0
2012		0.0
2013		0.0
2014	13	12.7
2015	13	12.8
2016	13	12.9
2017	13	13.1
2018	13	13.2
2019	13	13.3
2020	13	13.5
2021	14	13.6
2022	14	13.7
2023	14	13.9
2024	14	14.0
2025	14	14.2
2026	14	14.3
2027	14	14.4
2028	15	14.6
2029	15	14.7
2030	15	14.8
2031	15	15.0
2032	15	15.1
2033	15	15.2
2034	15	15.4
2035	15	15.5
2036	16	15.6
2037	16	15.8
2038	16	15.9
2039	16	16.0
2040	16	16.1
2041	16	16.3
2042	16	16.4
2043	17	16.6
2044	17	16.7
2045	17	16.8
2046	17	17.0
2047	17	17.1
2048	17	17.3
2049	17	17.4
2050	18	17.5
2051	18	17.7
2052	18	17.8
2053	18	17.9
2054	18	18.1
2055	18	18.2
2056	18	18.3
2057	18	18.4
2058	19	18.6
2059	19	18.7
2060	19	18.8
2061	19	19.0
2062	19	19.1
2063	19	19.2
2064	19	19.3
2065	19	19.4
2066	20	19.6
2067	20	19.7
2068	20	19.8
2069	20	19.9
2070	20	20.1

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	38	0
2015	7,423	43	(14)
2016	7,428	43	(14)
2017	7,434	43	(14)
2018	7,439	43	(14)
2019	7,445	43	(14)
2020	7,450	43	(14)
2021	7,539	43	(14)
2022	7,628	43	(14)
2023	7,718	43	(14)
2024	7,807	43	(14)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 13 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	13	(14)	(1)	13	0	0	0	12
2017	13	(14)	(0)	13	0	0	0	13
2018	13	(14)	(0)	13	0	0	0	13
2019	13	(14)	(0)	13	0	0	0	13
2020	13	(14)	(0)	14	0	0	0	13
2021	14	(14)	(0)	14	0	0	0	14
2022	14	(14)	(0)	14	0	0	0	14
2023	14	(14)	(0)	14	0	0	0	14
2024	14	(14)	(0)	14	0	0	0	14
2025	14	(14)	(0)	14	0	0	0	14
2026	14	(15)	(0)	14	0	0	0	14
2027	14	(15)	(0)	15	0	0	0	14
2028	15	(15)	(0)	15	0	0	0	14
2029	15	(15)	(0)	15	0	0	0	14
2030	15	(15)	(0)	15	0	0	0	15
2031	15	(15)	(0)	15	1	0	1	14
2032	15	(16)	(0)	15	2	0	2	13
2033	15	(16)	(0)	15	2	0	2	12
2034	15	(16)	(1)	16	3	0	3	12
2035	15	(16)	(1)	16	4	0	4	11
2036	16	(16)	(1)	16	5	0	5	10
2037	16	(16)	(1)	16	6	0	6	10
2038	16	(17)	(1)	16	7	0	7	9
2039	16	(17)	(1)	16	7	0	7	8
2040	16	(17)	(1)	16	8	0	8	7

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	13	(14)	(1)	3	0	0	0	3
2017	13	(14)	(0)	4	0	0	0	3
2018	13	(14)	(0)	4	0	0	0	3
2019	13	(14)	(0)	4	0	0	0	3
2020	13	(14)	(0)	4	0	0	0	3
2021	14	(14)	(0)	4	0	0	0	3
2022	14	(14)	(0)	4	0	0	0	4
2023	14	(14)	(0)	4	0	0	0	4
2024	14	(14)	(0)	4	0	0	0	4
2025	14	(14)	(0)	4	0	0	0	4
2026	14	(15)	(0)	4	0	0	0	4
2027	14	(15)	(0)	4	0	0	0	4
2028	15	(15)	(0)	4	0	0	0	4
2029	15	(15)	(0)	4	0	0	0	4
2030	15	(15)	(0)	4	0	0	0	4
2031	15	(15)	(0)	4	1	0	1	3
2032	15	(16)	(0)	4	2	0	2	2
2033	15	(16)	(0)	4	2	0	2	1
2034	15	(16)	(1)	4	3	0	3	0
2035	15	(16)	(1)	4	4	0	4	(0)
2036	16	(16)	(1)	4	5	0	5	(1)
2037	16	(16)	(1)	4	6	0	6	(2)
2038	16	(17)	(1)	4	7	0	7	(3)
2039	16	(17)	(1)	4	7	0	7	(4)
2040	16	(17)	(1)	4	8	0	8	(5)

3. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
City of Weslaco Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Weslaco's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Weslaco's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Weslaco's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Weslaco with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	229	72	301	35	0	35	266
2016	235	74	309	44	0	44	265
2017	240	76	316	44	0	44	273
2018	246	78	324	52	0	52	272
2019	251	80	331	61	0	61	270
2020	257	82	339	79	0	79	261
2021	262	84	346	100	0	100	247
2022	268	86	354	121	0	121	233
2023	273	88	361	142	0	142	219
2024	278	90	368	164	0	164	205
2025	284	92	376	185	0	185	192
2026	289	94	383	206	0	206	177
2027	295	96	391	227	0	227	164
2028	300	98	398	249	0	249	150
2029	306	100	406	270	0	270	137
2030	311	102	413	291	0	291	122
2031	317	104	421	308	0	308	113
2032	322	106	428	326	0	326	103
2033	328	108	436	343	0	343	93
2034	334	110	444	361	0	361	84
2035	339	112	451	378	0	378	73
2036	345	114	459	395	0	395	64
2037	351	116	467	413	0	413	55
2038	356	118	474	430	0	430	44
2039	362	120	482	448	0	448	35
2040	367	122	489	465	0	465	24
2041	373	124	497	488	0	488	9
2042	379	126	505	512	0	512	(6)
2043	385	128	513	535	0	535	(22)
2044	390	130	520	559	0	559	(38)
2045	396	132	528	582	0	582	(53)
2046	402	134	536	605	0	605	(69)
2047	408	137	545	629	0	629	(84)
2048	413	139	552	652	0	652	(100)
2049	419	141	560	675	0	675	(116)
2050	425	143	568	699	0	699	(131)
2051	431	145	576	728	0	728	(152)
2052	437	147	584	756	0	756	(173)
2053	443	149	592	785	0	785	(194)
2054	449	151	600	814	0	814	(215)
2055	455	153	608	843	0	843	(236)
2056	460	155	615	872	0	872	(257)
2057	466	157	623	901	0	901	(278)
2058	472	159	631	930	0	930	(299)
2059	478	161	639	959	0	959	(320)
2060	484	163	647	987	0	987	(341)
2061	490	165	655	1,020	0	1,020	(366)
2062	496	166	662	1,053	0	1,053	(390)
2063	501	168	669	1,085	0	1,085	(416)
2064	507	170	677	1,118	0	1,118	(441)
2065	513	172	685	1,151	0	1,151	(465)
2066	519	174	693	1,183	0	1,183	(490)
2067	524	176	700	1,216	0	1,216	(516)
2068	530	178	708	1,249	0	1,249	(541)
2069	536	180	716	1,281	0	1,281	(565)
2070	542	182	724	1,314	0	1,314	(590)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Weslaco's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	134	0	0	0
1	2015	39,474	137	(46)	301	347
2	2016	40,620	140	(95)	309	404
3	2017	41,766	144	(146)	316	463
4	2018	42,913	147	(200)	324	525
5-year Goal	2019	44,059	150	(257)	331	589
6	2020	45,205	150	(257)	339	597
7	2021	46,298	149	(257)	346	603
8	2022	47,390	149	(256)	354	610
9	2023	48,483	148	(255)	361	616
10-year Goal	2024	49,576	148	(253)	368	622

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Weslaco's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	24.00	0	0	0
1	2015	39,474	22.20	26	72	46
2	2016	40,620	20.40	53	74	21
3	2017	41,766	18.60	82	76	(6)
4	2018	42,913	16.80	113	78	(34)
5-year Goal	2019	44,059	15.00	145	80	(64)
6	2020	45,205	14.60	155	82	(73)
7	2021	46,298	14.20	166	84	(81)
8	2022	47,390	13.80	176	86	(90)
9	2023	48,483	13.40	188	88	(99)
10-year Goal	2024	49,576	13.00	199	90	(109)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 72 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
   a. Last rate increase:[17]
      i. 50% increase in 2014
   b. Estimated customer demand reduction of 10.0%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0.0
2010		0.0
2011		0.0
2012	213	213.0
2013	218	218.0
2014	224	223.8
2015	229	229.2
2016	235	234.7
2017	240	240.2
2018	246	245.6
2019	251	251.1
2020	257	256.6
2021	262	262.0
2022	268	267.5
2023	273	273.0
2024	278	278.5
2025	284	283.9
2026	289	289.4
2027	295	294.9
2028	300	300.3
2029	306	305.8
2030	311	311.3
2031	317	316.9
2032	322	322.5
2033	328	328.1
2034	334	333.7
2035	339	339.3
2036	345	344.9
2037	351	350.5
2038	356	356.1
2039	362	361.7
2040	367	367.3
2041	373	373.1
2042	379	378.9
2043	385	384.6
2044	390	390.4
2045	396	396.1
2046	402	401.9
2047	408	407.7
2048	413	413.4
2049	419	419.2
2050	425	425.0
2051	431	430.9
2052	437	436.8
2053	443	442.7
2054	449	448.6
2055	455	454.5
2056	460	460.4
2057	466	466.3
2058	472	472.2
2059	478	478.1
2060	484	484.0
2061	490	489.8
2062	496	495.6
2063	501	501.4
2064	507	507.1
2065	513	512.9
2066	519	518.7
2067	524	524.5
2068	530	530.3
2069	536	536.0
2070	542	541.8

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	24.00	0
2015	39,474	19.00	72
2016	40,620	19.00	74
2017	41,766	19.00	76
2018	42,913	19.00	78
2019	44,059	19.00	80
2020	45,205	19.00	82
2021	46,298	19.00	84
2022	47,390	19.00	86
2023	48,483	19.00	88
2024	49,576	19.00	90

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
        i. Average Region M savings
        ii. Specific percentage of outdoor usage unknown for your utility at this time
    b. Savings could be 119 MG per year with current demand.
    c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	235	74	309	119	44	0	44	384
2017	240	76	316	121	44	0	44	394
2018	246	78	324	124	52	0	52	396
2019	251	80	331	127	61	0	61	397
2020	257	82	339	130	79	0	79	391
2021	262	84	346	132	100	0	100	379
2022	268	86	354	135	121	0	121	369
2023	273	88	361	138	142	0	142	357
2024	278	90	368	141	164	0	164	346
2025	284	92	376	143	185	0	185	335
2026	289	94	383	146	206	0	206	324
2027	295	96	391	149	227	0	227	313
2028	300	98	398	152	249	0	249	302
2029	306	100	406	154	270	0	270	291
2030	311	102	413	157	291	0	291	280
2031	317	104	421	160	308	0	308	273
2032	322	106	428	163	326	0	326	265
2033	328	108	436	166	343	0	343	259
2034	334	110	444	169	361	0	361	252
2035	339	112	451	171	378	0	378	245
2036	345	114	459	174	395	0	395	238
2037	351	116	467	177	413	0	413	232
2038	356	118	474	180	430	0	430	224
2039	362	120	482	183	448	0	448	217
2040	367	122	489	185	465	0	465	210

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	235	74	309	31	44	0	44	297
2017	240	76	316	32	44	0	44	305
2018	246	78	324	33	52	0	52	305
2019	251	80	331	34	61	0	61	304
2020	257	82	339	34	79	0	79	295
2021	262	84	346	35	100	0	100	282
2022	268	86	354	36	121	0	121	269
2023	273	88	361	37	142	0	142	256
2024	278	90	368	37	164	0	164	242
2025	284	92	376	38	185	0	185	230
2026	289	94	383	39	206	0	206	216
2027	295	96	391	40	227	0	227	204
2028	300	98	398	40	249	0	249	190
2029	306	100	406	41	270	0	270	178
2030	311	102	413	42	291	0	291	164
2031	317	104	421	42	308	0	308	155
2032	322	106	428	43	326	0	326	146
2033	328	108	436	44	343	0	343	137
2034	334	110	444	45	361	0	361	129
2035	339	112	451	45	378	0	378	119
2036	345	114	459	46	395	0	395	110
2037	351	116	467	47	413	0	413	102
2038	356	118	474	48	430	0	430	92
2039	362	120	482	48	448	0	448	83
2040	367	122	489	49	465	0	465	74

3. Rain Barrels
    a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Statewide Water Conservation Quantification Project
Zapata County Waterworks Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential

WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Zapata County Waterworks's current water conservation activities and their quantified savings to two metrics: 1) Region M Water Plan's (Texas Water Development Board, 2016k) recommended WMS supply volumes for municipal conservation, and 2) Zapata County Waterworks's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Zapata County Waterworks's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe.

---

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

---

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Zapata County Waterworks with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

---

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	17.5	(9)	9	12	0	12	(3)
2016	34.1	(9)	25	15	0	15	11
2017	34.6	(9)	26	15	0	15	11
2018	35.1	(9)	26	18	0	18	8
2019	35.7	(9)	26	21	0	21	6
2020	36.2	(10)	27	26	0	26	0
2021	36.7	(10)	27	33	0	33	(6)
2022	37.3	(10)	27	40	0	40	(13)
2023	37.8	(10)	28	47	0	47	(19)
2024	38.3	(10)	28	54	0	54	(26)
2025	38.8	(10)	29	61	0	61	(33)
2026	39.4	(10)	29	68	0	68	(39)
2027	39.9	(11)	29	75	0	75	(46)
2028	40.4	(11)	30	82	0	82	(52)
2029	41.0	(11)	30	89	0	89	(59)
2030	41.5	(11)	30	96	0	96	(65)
2031	42.1	(11)	31	102	0	102	(71)
2032	42.7	(12)	31	109	0	109	(77)
2033	43.3	(12)	32	115	0	115	(83)
2034	43.9	(12)	32	121	0	121	(89)
2035	44.5	(12)	32	128	0	128	(95)
2036	45.1	(12)	33	134	0	134	(101)
2037	45.7	(12)	33	141	0	141	(107)
2038	46.3	(13)	34	147	0	147	(113)
2039	46.9	(13)	34	154	0	154	(119)
2040	47.5	(13)	35	160	0	160	(125)
2041	48.2	(13)	35	167	0	167	(132)
2042	48.9	(13)	36	173	0	173	(138)
2043	49.5	(14)	36	180	0	180	(144)
2044	50.2	(14)	36	186	0	186	(150)
2045	50.9	(14)	37	193	0	193	(156)
2046	51.6	(14)	37	199	0	199	(162)
2047	52.3	(14)	38	206	0	206	(168)
2048	53.0	(15)	38	212	0	212	(174)
2049	53.7	(15)	39	219	0	219	(180)
2050	54.3	(15)	39	226	0	226	(186)
2051	55.1	(15)	40	234	0	234	(194)
2052	55.8	(15)	40	242	0	242	(201)
2053	56.5	(16)	41	250	0	250	(209)
2054	57.3	(16)	42	258	0	258	(217)
2055	58.0	(16)	42	266	0	266	(224)
2056	58.7	(16)	43	274	0	274	(232)
2057	59.5	(16)	43	283	0	283	(239)
2058	60.2	(17)	44	291	0	291	(247)
2059	60.9	(17)	44	299	0	299	(255)
2060	61.7	(17)	45	307	0	307	(262)
2061	62.4	(17)	45	316	0	316	(271)
2062	63.2	(17)	46	326	0	326	(280)
2063	64.0	(18)	46	335	0	335	(289)
2064	64.8	(18)	47	345	0	345	(298)
2065	65.5	(18)	48	354	0	354	(307)
2066	66.3	(18)	48	364	0	364	(316)
2067	67.1	(18)	49	373	0	373	(325)
2068	67.8	(19)	49	383	0	383	(333)
2069	68.6	(19)	50	392	0	392	(342)
2070	69.4	(19)	50	402	0	402	(351)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Zapata County Waterworks's quantified savings from its implemented activities compare with 5- 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	114	0	0	0
1	2015	11,928	115	(3)	17.5	20
2	2016	12,149	115	(5)	34.1	39
3	2017	12,370	116	(8)	34.6	43
4	2018	12,590	116	(11)	35.1	46
5-year Goal	2019	12,811	117	(14)	35.7	50
6	2020	13,032	116	(11)	36.2	48
7	2021	13,256	116	(9)	36.7	45
8	2022	13,480	115	(6)	37.3	43
9	2023	13,704	115	(3)	37.8	41
10-year Goal	2024	13,928	114	0	38.3	38

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Zapata County Waterworks's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2015	11,928	12.00	0	(9)	(9)
2	2016	12,149	12.00	0	(9)	(9)
3	2017	12,370	12.00	0	(9)	(9)
4	2018	12,590	12.00	0	(9)	(9)
5-year Goal	2019	12,811	12.00	0	(9)	(9)
6	2020	13,032	11.60	2	(10)	(11)
7	2021	13,256	11.20	4	(10)	(14)
8	2022	13,480	10.80	6	(10)	(16)
9	2023	13,704	10.40	8	(10)	(18)
10-year Goal	2024	13,928	10.00	10	(10)	(20)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Loss of 9 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
   a. Last rate increases:[17]
      i. 12.46% increase in 2015
      ii. 11.07% increase in 2016
   b. Estimated customer demand reduction of 4.6%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] W The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases..

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0.0
2010		0.0
2011		0.0
2012		0.0
2013		0.0
2014		0.0
2015	17.5	17.5
2016	34.1	34.1
2017	34.6	34.6
2018	35.1	35.1
2019	35.7	35.7
2020	36.2	36.2
2021	36.7	36.7
2022	37.3	37.3
2023	37.8	37.8
2024	38.3	38.3
2025	38.8	38.8
2026	39.4	39.4
2027	39.9	39.9
2028	40.4	40.4
2029	41.0	41.0
2030	41.5	41.5
2031	42.1	42.1
2032	42.7	42.7
2033	43.3	43.3
2034	43.9	43.9
2035	44.5	44.5
2036	45.1	45.1
2037	45.7	45.7
2038	46.3	46.3
2039	46.9	46.9
2040	47.5	47.5
2041	48.2	48.2
2042	48.9	48.9
2043	49.5	49.5
2044	50.2	50.2
2045	50.9	50.9
2046	51.6	51.6
2047	52.3	52.3
2048	53.0	53.0
2049	53.7	53.7
2050	54.3	54.3
2051	55.1	55.1
2052	55.8	55.8
2053	56.5	56.5
2054	57.3	57.3
2055	58.0	58.0
2056	58.7	58.7
2057	59.5	59.5
2058	60.2	60.2
2059	60.9	60.9
2060	61.7	61.7
2061	62.4	62.4
2062	63.2	63.2
2063	64.0	64.0
2064	64.8	64.8
2065	65.5	65.5
2066	66.3	66.3
2067	67.1	67.1
2068	67.8	67.8
2069	68.6	68.6
2070	69.4	69.4

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	12.00	0
2015	11,928	14.00	(9)
2016	12,149	14.00	(9)
2017	12,370	14.00	(9)
2018	12,590	14.00	(9)
2019	12,811	14.00	(9)
2020	13,032	14.00	(10)
2021	13,256	14.00	(10)
2022	13,480	14.00	(10)
2023	13,704	14.00	(10)
2024	13,928	14.00	(10)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 5.05% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region M savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 37 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	34	(9)	25	37	15	0	15	48
2017	35	(9)	26	38	15	0	15	49
2018	35	(9)	26	39	18	0	18	47
2019	36	(9)	26	39	21	0	21	45
2020	36	(10)	27	40	26	0	26	40
2021	37	(10)	27	40	33	0	33	34
2022	37	(10)	27	41	40	0	40	28
2023	38	(10)	28	41	47	0	47	22
2024	38	(10)	28	42	54	0	54	16
2025	39	(10)	29	43	61	0	61	10
2026	39	(10)	29	43	68	0	68	4
2027	40	(11)	29	44	75	0	75	(2)
2028	40	(11)	30	44	82	0	82	(8)
2029	41	(11)	30	45	89	0	89	(14)
2030	41	(11)	30	46	96	0	96	(20)
2031	42	(11)	31	46	102	0	102	(25)
2032	43	(12)	31	47	109	0	109	(31)
2033	43	(12)	32	48	115	0	115	(36)
2034	44	(12)	32	48	121	0	121	(41)
2035	44	(12)	32	49	128	0	128	(47)
2036	45	(12)	33	49	134	0	134	(52)
2037	46	(12)	33	50	141	0	141	(57)
2038	46	(13)	34	51	147	0	147	(63)
2039	47	(13)	34	51	154	0	154	(68)
2040	47	(13)	35	52	160	0	160	(73)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	34	(9)	25	10	15	0	15	20
2017	35	(9)	26	10	15	0	15	21
2018	35	(9)	26	10	18	0	18	19
2019	36	(9)	26	10	21	0	21	16
2020	36	(10)	27	11	26	0	26	11
2021	37	(10)	27	11	33	0	33	4
2022	37	(10)	27	11	40	0	40	(2)
2023	38	(10)	28	11	47	0	47	(8)
2024	38	(10)	28	11	54	0	54	(15)
2025	39	(10)	29	11	61	0	61	(21)
2026	39	(10)	29	11	68	0	68	(28)
2027	40	(11)	29	12	75	0	75	(34)
2028	40	(11)	30	12	82	0	82	(41)
2029	41	(11)	30	12	89	0	89	(47)
2030	41	(11)	30	12	96	0	96	(53)
2031	42	(11)	31	12	102	0	102	(59)
2032	43	(12)	31	12	109	0	109	(65)
2033	43	(12)	32	13	115	0	115	(71)
2034	44	(12)	32	13	121	0	121	(77)
2035	44	(12)	32	13	128	0	128	(83)
2036	45	(12)	33	13	134	0	134	(88)
2037	46	(12)	33	13	141	0	141	(94)
2038	46	(13)	34	13	147	0	147	(100)
2039	47	(13)	34	14	154	0	154	(106)
2040	47	(13)	35	14	160	0	160	(112)

3. Rain Barrels
   a. In Region M, utilities could save approximately 13.1 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

Region N Individual Reports

Statewide Water Conservation Quantification Project
Nueces County WCID #3 Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common

[1] Equal to 811,224 acre-feet per year in conservation savings.

association

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached, after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.

assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Nueces County WCID #3's current water conservation activities and their quantified savings to two metrics: 1) Region N Water Plan's (Texas Water Development Board, 2016l) recommended WMS supply volumes for municipal conservation, and 2) Nueces County WCID #3's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Nueces County WCID #3's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe.

These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8]

---

[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.
[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

9

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

---

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365
[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Nueces County WCID #3 with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	0	26	26	18	0	18	8
2016	0	26	26	23	0	23	4
2017	0	26	26	23	0	23	4
2018	0	27	27	27	0	27	0
2019	0	27	27	32	0	32	(5)
2020	0	27	27	41	0	41	(13)
2021	0	27	27	48	0	48	(20)
2022	0	27	27	54	0	54	(27)
2023	0	27	27	61	0	61	(34)
2024	0	27	27	68	0	68	(41)
2025	0	27	27	75	0	75	(48)
2026	0	27	27	82	0	82	(55)
2027	0	27	27	89	0	89	(62)
2028	0	27	27	96	0	96	(68)
2029	0	27	27	103	0	103	(75)
2030	0	27	27	110	0	110	(82)
2031	0	27	27	116	0	116	(89)
2032	0	27	27	122	0	122	(95)
2033	0	27	27	129	0	129	(101)
2034	0	27	27	135	0	135	(108)
2035	0	27	27	141	0	141	(114)
2036	0	27	27	148	0	148	(121)
2037	0	27	27	154	0	154	(127)
2038	0	27	27	161	0	161	(133)
2039	0	27	27	167	0	167	(140)
2040	0	27	27	173	0	173	(146)
2041	0	27	27	180	0	180	(153)
2042	0	27	27	187	0	187	(160)
2043	0	27	27	194	0	194	(167)
2044	0	27	27	202	0	202	(174)
2045	0	27	27	209	0	209	(181)
2046	0	27	27	216	0	216	(188)
2047	0	27	27	223	0	223	(195)
2048	0	27	27	230	0	230	(202)
2049	0	27	27	237	0	237	(209)
2050	0	27	27	244	0	244	(216)
2051	0	27	27	248	0	248	(221)
2052	0	27	27	253	0	253	(225)
2053	0	27	27	257	0	257	(230)
2054	0	27	27	262	0	262	(234)
2055	0	27	27	266	0	266	(239)
2056	0	27	27	270	0	270	(243)
2057	0	27	27	275	0	275	(247)
2058	0	27	27	279	0	279	(252)
2059	0	27	27	284	0	284	(256)
2060	0	27	27	288	0	288	(261)
2061	0	27	27	288	0	288	(261)
2062	0	27	27	288	0	288	(261)
2063	0	27	27	288	0	288	(261)
2064	0	27	27	288	0	288	(261)
2065	0	27	27	288	0	288	(261)
2066	0	27	27	288	0	288	(261)
2067	0	27	27	288	0	288	(261)
2068	0	27	27	288	0	288	(261)
2069	0	27	27	288	0	288	(261)
2070	0	27	27	288	0	288	(261)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Nueces County WCID #3's quantified savings from its implemented activities compare with 5- 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	112	0	0	0
1	2015	11,800	112	1	26	25
2	2016	11,933	112	2	26	24
3	2017	12,067	111	3	26	24
4	2018	12,200	111	4	27	23
5-year Goal	2019	12,334	111	5	27	23
6	2020	12,467	111	6	27	21
7	2021	12,467	110	8	27	19
8	2022	12,468	110	10	27	17
9	2023	12,468	109	12	27	15
10-year Goal	2024	12,468	109	14	27	14

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Nueces County WCID #3's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	20.00	0	0	0
1	2015	11,800	19.80	1	21	20
2	2016	11,933	19.60	2	21	20
3	2017	12,067	19.40	3	22	19
4	2018	12,200	19.20	4	23	19
5-year Goal	2019	12,334	19.00	5	24	19
6	2020	12,467	18.20	8	26	18
7	2021	12,467	17.40	12	29	17
8	2022	12,468	16.60	15	32	17
9	2023	12,468	15.80	19	35	16
10-year Goal	2024	12,468	15.00	23	38	15

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Savings of 26 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

5 Summary of Savings

Table 5-1. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	20.00	0
2015	11,800	14.00	26
2016	11,933	14.00	26
2017	12,067	14.00	26
2018	12,200	14.00	27
2019	12,334	14.00	27
2020	12,467	14.00	27
2021	12,467	14.00	27
2022	12,468	14.00	27
2023	12,468	14.00	27
2024	12,468	14.00	27

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
  - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  - i. This was the most common percentage of residential use among participating utilities in this project.
  - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[17]
- **g.** See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[17] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	26	26	13	23	0	23	17
2017	0	26	26	13	23	0	23	17
2018	0	27	27	13	27	0	27	13
2019	0	27	27	13	32	0	32	8
2020	0	27	27	13	41	0	41	(1)
2021	0	27	27	13	48	0	48	(7)
2022	0	27	27	13	54	0	54	(14)
2023	0	27	27	13	61	0	61	(21)
2024	0	27	27	13	68	0	68	(28)
2025	0	27	27	13	75	0	75	(35)
2026	0	27	27	13	82	0	82	(42)
2027	0	27	27	13	89	0	89	(49)
2028	0	27	27	13	96	0	96	(56)
2029	0	27	27	13	103	0	103	(63)
2030	0	27	27	13	110	0	110	(70)
2031	0	27	27	13	116	0	116	(76)
2032	0	27	27	13	122	0	122	(82)
2033	0	27	27	13	129	0	129	(89)
2034	0	27	27	13	135	0	135	(95)
2035	0	27	27	13	141	0	141	(102)
2036	0	27	27	13	148	0	148	(108)
2037	0	27	27	13	154	0	154	(114)
2038	0	27	27	12	161	0	161	(121)
2039	0	27	27	12	167	0	167	(127)
2040	0	27	27	12	173	0	173	(134)

2. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 19 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	0	26	26	19	23	0	23	23
2017	0	26	26	19	23	0	23	23
2018	0	27	27	19	27	0	27	19
2019	0	27	27	19	32	0	32	15
2020	0	27	27	19	41	0	41	6
2021	0	27	27	19	48	0	48	(1)
2022	0	27	27	19	54	0	54	(8)
2023	0	27	27	19	61	0	61	(15)
2024	0	27	27	19	68	0	68	(22)
2025	0	27	27	19	75	0	75	(29)
2026	0	27	27	19	82	0	82	(36)
2027	0	27	27	19	89	0	89	(43)
2028	0	27	27	19	96	0	96	(49)
2029	0	27	27	19	103	0	103	(56)
2030	0	27	27	19	110	0	110	(63)
2031	0	27	27	19	116	0	116	(70)
2032	0	27	27	19	122	0	122	(76)
2033	0	27	27	19	129	0	129	(83)
2034	0	27	27	19	135	0	135	(89)
2035	0	27	27	19	141	0	141	(95)
2036	0	27	27	19	148	0	148	(102)
2037	0	27	27	19	154	0	154	(108)
2038	0	27	27	19	161	0	161	(115)
2039	0	27	27	19	167	0	167	(121)
2040	0	27	27	19	173	0	173	(127)

3. Rain Barrels
   a. In Region N, utilities could save approximately 16 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
   b. Estimated 10-year useful life for most barrels

TWDB Statewide Water Conservation Quantification Project
City of Corpus Christi Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Corpus Christi's current water conservation activities and their quantified savings to two metrics: 1) Region N Water Plan's (Texas Water Development Board, 2016l) recommended WMS supply volumes for municipal conservation, and 2) Corpus Christi's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Corpus Christi's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in TWDB water conservation plan annual report (Texas Water Development Board, 2016o): (Total Water Loss ÷ Permanent Population) ÷ 365

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Corpus Christi with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	280	228	508	334	0	334	174
2016	1,114	234	1,348	417	0	417	931
2017	1,121	241	1,362	417	0	417	945
2018	1,129	247	1,376	501	0	501	875
2019	1,136	254	1,389	584	0	584	805
2020	1,143	260	1,403	751	0	751	652
2021	1,150	263	1,413	916	0	916	497
2022	1,158	265	1,423	1,080	0	1,080	343
2023	1,165	268	1,433	1,245	0	1,245	188
2024	1,172	270	1,442	1,409	0	1,409	33
2025	1,179	273	1,452	1,574	0	1,574	(122)
2026	1,187	275	1,462	1,738	0	1,738	(276)
2027	1,194	278	1,472	1,903	0	1,903	(431)
2028	1,201	280	1,482	2,068	0	2,068	(586)
2029	1,209	283	1,491	2,232	0	2,232	(741)
2030	1,216	285	1,501	2,397	0	2,397	(895)
2031	1,220	287	1,507	2,515	0	2,515	(1,008)
2032	1,224	289	1,513	2,633	0	2,633	(1,121)
2033	1,228	290	1,518	2,752	0	2,752	(1,233)
2034	1,232	292	1,524	2,870	0	2,870	(1,346)
2035	1,236	293	1,530	2,988	0	2,988	(1,459)
2036	1,241	295	1,536	3,107	0	3,107	(1,571)
2037	1,245	297	1,541	3,225	0	3,225	(1,684)
2038	1,249	298	1,547	3,343	0	3,343	(1,796)
2039	1,253	300	1,553	3,462	0	3,462	(1,909)
2040	1,257	301	1,558	3,580	0	3,580	(2,022)
2041	1,260	304	1,563	3,570	0	3,570	(2,006)
2042	1,262	307	1,569	3,559	0	3,559	(1,991)
2043	1,265	309	1,574	3,549	0	3,549	(1,975)
2044	1,267	312	1,579	3,539	0	3,539	(1,960)
2045	1,269	314	1,584	3,528	0	3,528	(1,944)
2046	1,272	317	1,589	3,518	0	3,518	(1,929)
2047	1,274	320	1,594	3,507	0	3,507	(1,913)
2048	1,277	322	1,599	3,497	0	3,497	(1,898)
2049	1,279	325	1,604	3,487	0	3,487	(1,882)
2050	1,282	328	1,610	3,476	0	3,476	(1,867)
2051	1,284	329	1,614	3,480	0	3,480	(1,866)
2052	1,287	331	1,618	3,483	0	3,483	(1,865)
2053	1,289	332	1,622	3,486	0	3,486	(1,864)
2054	1,292	334	1,626	3,489	0	3,489	(1,863)
2055	1,294	336	1,630	3,492	0	3,492	(1,863)
2056	1,297	337	1,634	3,496	0	3,496	(1,862)
2057	1,299	339	1,638	3,499	0	3,499	(1,861)
2058	1,301	340	1,642	3,502	0	3,502	(1,860)
2059	1,304	342	1,646	3,505	0	3,505	(1,859)
2060	1,306	343	1,650	3,508	0	3,508	(1,859)
2061	1,308	344	1,652	3,513	0	3,513	(1,860)
2062	1,310	345	1,655	3,517	0	3,517	(1,862)
2063	1,312	346	1,658	3,521	0	3,521	(1,864)
2064	1,313	347	1,660	3,526	0	3,526	(1,865)
2065	1,315	348	1,663	3,530	0	3,530	(1,867)
2066	1,317	349	1,665	3,534	0	3,534	(1,869)
2067	1,319	349	1,668	3,539	0	3,539	(1,871)
2068	1,320	350	1,671	3,543	0	3,543	(1,872)
2069	1,322	351	1,673	3,547	0	3,547	(1,874)
2070	1,324	352	1,676	3,552	0	3,552	(1,876)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Corpus Christi's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	205	0	0	0
1	2014	310,719	203	227	278	51
2	2015	312,065	201	456	508	52
3	2016	320,877	199	703	1,348	646
4	2017	329,688	197	963	1,362	399
5-year Goal	2018	338,500	195	1,236	1,376	140
6	2019	347,311	193	1,547	1,389	(157)
7	2020	356,123	191	1,872	1,403	(469)
8	2021	359,618	188	2,179	1,413	(766)
9	2022	363,114	186	2,492	1,423	(1,069)
10-year Goal	2023	366,609	184	2,810	1,433	(1,377)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Corpus Christi's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	17.00	0	0	0
1	2014	310,719	16.40	68	-	-
2	2015	312,065	15.80	137	228	91
3	2016	320,877	15.20	211	234	23
4	2017	329,688	14.60	289	241	(48)
5-year Goal	2018	338,500	14.00	371	247	(124)
6	2019	347,311	13.80	406	254	(152)
7	2020	356,123	13.60	442	260	(182)
8	2021	359,618	13.40	473	263	(210)
9	2022	363,114	13.20	504	265	(239)
10-year Goal	2023	366,609	13.00	535	268	(268)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 228 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 7.8% increase for residential and 3.0% increase for commercial in 2014
        ii. 21.9% increase for residential and 13.6% increase for commercial in 2016
    b. Estimated customer demand reduction of 5.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
        i. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Rain Barrels	Water Rate Increases	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013	N/A		0
2014	N/A	278.0	278
2015	N/A	279.8	280
2016	N/A	1,114.2	1,114
2017	N/A	1,121.4	1,121
2018	N/A	1,128.7	1,129
2019	N/A	1,135.9	1,136
2020	N/A	1,143.2	1,143
2021	N/A	1,150.5	1,150
2022	N/A	1,157.7	1,158
2023	N/A	1,165.0	1,165
2024	N/A	1,172.2	1,172
2025	N/A	1,179.5	1,179
2026	N/A	1,186.8	1,187
2027	N/A	1,194.0	1,194
2028	N/A	1,201.3	1,201
2029	N/A	1,208.5	1,209
2030	N/A	1,215.8	1,216
2031	N/A	1,219.9	1,220
2032	N/A	1,224.0	1,224
2033	N/A	1,228.2	1,228
2034	N/A	1,232.3	1,232
2035	N/A	1,236.4	1,236
2036	N/A	1,240.5	1,241
2037	N/A	1,244.7	1,245
2038	N/A	1,248.8	1,249
2039	N/A	1,252.9	1,253
2040	N/A	1,257.0	1,257
2041	N/A	1,259.5	1,260
2042	N/A	1,262.0	1,262
2043	N/A	1,264.5	1,265
2044	N/A	1,267.0	1,267
2045	N/A	1,269.5	1,269
2046	N/A	1,272.0	1,272
2047	N/A	1,274.4	1,274
2048	N/A	1,276.9	1,277
2049	N/A	1,279.4	1,279
2050	N/A	1,281.9	1,282
2051	N/A	1,284.3	1,284
2052	N/A	1,286.8	1,287
2053	N/A	1,289.2	1,289
2054	N/A	1,291.7	1,292
2055	N/A	1,294.1	1,294
2056	N/A	1,296.6	1,297
2057	N/A	1,299.0	1,299
2058	N/A	1,301.4	1,301
2059	N/A	1,303.9	1,304
2060	N/A	1,306.3	1,306
2061	N/A	1,308.1	1,308
2062	N/A	1,309.8	1,310
2063	N/A	1,311.6	1,312
2064	N/A	1,313.3	1,313
2065	N/A	1,315.1	1,315
2066	N/A	1,316.8	1,317
2067	N/A	1,318.6	1,319
2068	N/A	1,320.3	1,320
2069	N/A	1,322.1	1,322
2070	N/A	1,323.9	1,324

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	17.00	0
2015	312,065	15.00	228
2016	320,877	15.00	234
2017	329,688	15.00	241
2018	338,500	15.00	247
2019	347,311	15.00	254
2020	356,123	15.00	260
2021	359,618	15.00	263
2022	363,114	15.00	265
2023	366,609	15.00	268
2024	370,105	15.00	270

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - o The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - o Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
    - **a.** Potentially 4.84% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
    - **b.** Savings could be 996 MG per year with current demand.
    - **c.** See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,114	234	1,348	996	417	0	417	1,927
2017	1,121	241	1,362	1,003	417	0	417	1,948
2018	1,129	247	1,376	1,009	501	0	501	1,884
2019	1,136	254	1,389	1,016	584	0	584	1,821
2020	1,143	260	1,403	1,022	751	0	751	1,674
2021	1,150	263	1,413	1,029	916	0	916	1,526
2022	1,158	265	1,423	1,035	1,080	0	1,080	1,378
2023	1,165	268	1,433	1,042	1,245	0	1,245	1,230
2024	1,172	270	1,442	1,048	1,409	0	1,409	1,081
2025	1,179	273	1,452	1,055	1,574	0	1,574	933
2026	1,187	275	1,462	1,061	1,738	0	1,738	785
2027	1,194	278	1,472	1,068	1,903	0	1,903	637
2028	1,201	280	1,482	1,074	2,068	0	2,068	488
2029	1,209	283	1,491	1,081	2,232	0	2,232	340
2030	1,216	285	1,501	1,087	2,397	0	2,397	192
2031	1,220	287	1,507	1,091	2,515	0	2,515	83
2032	1,224	289	1,513	1,095	2,633	0	2,633	(26)
2033	1,228	290	1,518	1,098	2,752	0	2,752	(135)
2034	1,232	292	1,524	1,102	2,870	0	2,870	(244)
2035	1,236	293	1,530	1,106	2,988	0	2,988	(353)
2036	1,241	295	1,536	1,109	3,107	0	3,107	(462)
2037	1,245	297	1,541	1,113	3,225	0	3,225	(571)
2038	1,249	298	1,547	1,117	3,343	0	3,343	(680)
2039	1,253	300	1,553	1,120	3,462	0	3,462	(789)
2040	1,257	301	1,558	1,124	3,580	0	3,580	(897)

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	1,114	234	1,348	276	417	0	417	1,207
2017	1,121	241	1,362	278	417	0	417	1,222
2018	1,129	247	1,376	279	501	0	501	1,154
2019	1,136	254	1,389	281	584	0	584	1,086
2020	1,143	260	1,403	283	751	0	751	935
2021	1,150	263	1,413	285	916	0	916	782
2022	1,158	265	1,423	287	1,080	0	1,080	629
2023	1,165	268	1,433	288	1,245	0	1,245	476
2024	1,172	270	1,442	290	1,409	0	1,409	323
2025	1,179	273	1,452	292	1,574	0	1,574	170
2026	1,187	275	1,462	294	1,738	0	1,738	17
2027	1,194	278	1,472	296	1,903	0	1,903	(136)
2028	1,201	280	1,482	297	2,068	0	2,068	(288)
2029	1,209	283	1,491	299	2,232	0	2,232	(441)
2030	1,216	285	1,501	301	2,397	0	2,397	(594)
2031	1,220	287	1,507	302	2,515	0	2,515	(706)
2032	1,224	289	1,513	303	2,633	0	2,633	(818)
2033	1,228	290	1,518	304	2,752	0	2,752	(929)
2034	1,232	292	1,524	305	2,870	0	2,870	(1,041)
2035	1,236	293	1,530	306	2,988	0	2,988	(1,152)
2036	1,241	295	1,536	307	3,107	0	3,107	(1,264)
2037	1,245	297	1,541	308	3,225	0	3,225	(1,376)
2038	1,249	298	1,547	309	3,343	0	3,343	(1,487)
2039	1,253	300	1,553	310	3,462	0	3,462	(1,599)
2040	1,257	301	1,558	311	3,580	0	3,580	(1,710)

3. Rain Barrels
    a. In Region N, utilities could save approximately 16 gallons per year per gallon of capacity rebated, sold, or distributed (GDS Associates, 2002).
    b. Estimated 10-year useful life for most barrels

Region O Individual Reports

Statewide Water Conservation Quantification Project
City of Brownfield Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Brownfield's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Brownfield's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Brownfield's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Brownfield with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	7.8	3.6	11	13	0	13	(2)
2016	22.5	3.6	26	16	0	16	10
2017	22.6	3.6	26	16	0	16	10
2018	22.6	3.7	26	20	0	20	7
2019	22.7	3.7	26	23	0	23	4
2020	22.8	3.8	27	29	0	29	(3)
2021	22.9	3.8	27	29	0	29	(3)
2022	22.9	3.8	27	30	0	30	(3)
2023	23.0	3.9	27	30	0	30	(3)
2024	23.1	3.9	27	30	0	30	(3)
2025	23.2	3.9	27	30	0	30	(3)
2026	23.3	3.9	27	30	0	30	(3)
2027	23.3	4.0	27	30	0	30	(3)
2028	23.4	4.0	27	30	0	30	(3)
2029	23.5	4.0	27	30	0	30	(3)
2030	23.6	4.0	28	30	0	30	(3)
2031	23.7	4.1	28	30	0	30	(3)
2032	23.7	4.1	28	30	0	30	(2)
2033	23.8	4.1	28	30	0	30	(2)
2034	23.9	4.1	28	30	0	30	(2)
2035	24.0	4.1	28	30	0	30	(2)
2036	24.1	4.2	28	30	0	30	(2)
2037	24.2	4.2	28	30	0	30	(2)
2038	24.3	4.2	28	30	0	30	(2)
2039	24.4	4.2	29	30	0	30	(1)
2040	24.4	4.3	29	30	0	30	(1)
2041	24.5	4.3	29	29	0	29	(0)
2042	24.6	4.3	29	28	0	28	0
2043	24.7	4.3	29	28	0	28	1
2044	24.8	4.4	29	27	0	27	2
2045	24.9	4.4	29	26	0	26	3
2046	25.0	4.4	29	25	0	25	4
2047	25.1	4.4	30	25	0	25	5
2048	25.2	4.4	30	24	0	24	6
2049	25.3	4.5	30	23	0	23	7
2050	25.4	4.5	30	22	0	22	7
2051	25.5	4.5	30	23	0	23	7
2052	25.6	4.5	30	23	0	23	7
2053	25.8	4.5	30	23	0	23	8
2054	25.9	4.6	30	23	0	23	8
2055	26.0	4.6	31	23	0	23	8
2056	26.1	4.6	31	23	0	23	8
2057	26.2	4.6	31	23	0	23	8
2058	26.3	4.7	31	23	0	23	8
2059	26.4	4.7	31	23	0	23	8
2060	26.5	4.7	31	23	0	23	8
2061	26.6	4.7	31	24	0	24	8
2062	26.7	4.7	31	24	0	24	8
2063	26.9	4.8	32	24	0	24	8
2064	27.0	4.8	32	24	0	24	8
2065	27.1	4.8	32	24	0	24	8
2066	27.2	4.8	32	24	0	24	8
2067	27.3	4.8	32	24	0	24	8
2068	27.4	4.8	32	24	0	24	8
2069	27.5	4.9	32	24	0	24	8
2070	27.6	4.9	32	24	0	24	8

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Brownfield's quantified savings from its implemented activities compare with 5- 10 year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	143	0	0	0
1	2015	9,736	141	6	11	5
2	2016	9,865	139	13	26	13
3	2017	9,994	138	20	26	7
4	2018	10,123	136	27	26	0
5-year Goal	2019	10,252	134	34	26	(7)
6	2020	10,381	133	36	27	(10)
7	2021	10,447	133	39	27	(12)
8	2022	10,512	132	41	27	(15)
9	2023	10,578	132	44	27	(17)
10-year Goal	2024	10,643	131	47	27	(20)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Brownfield's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	6.00	0	0	0
1	2015	9,736	5.60	1	3.6	2
2	2016	9,865	5.20	3	3.6	1
3	2017	9,994	4.80	4	3.6	(1)
4	2018	10,123	4.40	6	3.7	(2)
5-year Goal	2019	10,252	4.00	7	3.7	(4)
6	2020	10,381	3.80	8	3.8	(5)
7	2021	10,447	3.60	9	3.8	(5)
8	2022	10,512	3.40	10	3.8	(6)
9	2023	10,578	3.20	11	3.9	(7)
10-year Goal	2024	10,643	3.00	12	3.9	(8)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 3.6 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 6.8% increase in 2015
        ii. 12.8% increase in 2016
    b. Estimated customer demand reduction of 5.26%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009		0
2010		0
2011		0
2012		0
2013		0
2014		0
2015	7.8	7.8
2016	22.5	22.5
2017	22.6	22.6
2018	22.6	22.6
2019	22.7	22.7
2020	22.8	22.8
2021	22.9	22.9
2022	22.9	22.9
2023	23.0	23.0
2024	23.1	23.1
2025	23.2	23.2
2026	23.3	23.3
2027	23.3	23.3
2028	23.4	23.4
2029	23.5	23.5
2030	23.6	23.6
2031	23.7	23.7
2032	23.7	23.7
2033	23.8	23.8
2034	23.9	23.9
2035	24.0	24.0
2036	24.1	24.1
2037	24.2	24.2
2038	24.3	24.3
2039	24.4	24.4
2040	24.4	24.4
2041	24.5	24.5
2042	24.6	24.6
2043	24.7	24.7
2044	24.8	24.8
2045	24.9	24.9
2046	25.0	25.0
2047	25.1	25.1
2048	25.2	25.2
2049	25.3	25.3
2050	25.4	25.4
2051	25.5	25.5
2052	25.6	25.6
2053	25.8	25.8
2054	25.9	25.9
2055	26.0	26.0
2056	26.1	26.1
2057	26.2	26.2
2058	26.3	26.3
2059	26.4	26.4
2060	26.5	26.5
2061	26.6	26.6
2062	26.7	26.7
2063	26.9	26.9
2064	27.0	27.0
2065	27.1	27.1
2066	27.2	27.2
2067	27.3	27.3
2068	27.4	27.4
2069	27.5	27.5
2070	27.6	27.6

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	6.00	0
2015	9,736	5.00	4
2016	9,865	5.00	4
2017	9,994	5.00	4
2018	10,123	5.00	4
2019	10,252	5.00	4
2020	10,381	5.00	4
2021	10,447	5.00	4
2022	10,512	5.00	4
2023	10,578	5.00	4
2024	10,643	5.00	4

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
    - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications

b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)

c. Estimate assumes customers will save 10% of total annual use due to the portal

  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)

d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB

  i. This was the most common percentage of residential use among participating utilities in this project.

  ii. Actual customer class demand percentages will vary by utility.

e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand

f. Savings are assumed to increase along with demand as connections increase each year[19]

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	22	4	26	8	16	0	16	18
2017	23	4	26	8	16	0	16	18
2018	23	4	26	8	20	0	20	15
2019	23	4	26	8	23	0	23	11
2020	23	4	27	8	29	0	29	5
2021	23	4	27	8	29	0	29	5
2022	23	4	27	8	30	0	30	5
2023	23	4	27	8	30	0	30	5
2024	23	4	27	8	30	0	30	5
2025	23	4	27	8	30	0	30	5
2026	23	4	27	8	30	0	30	5
2027	23	4	27	8	30	0	30	5
2028	23	4	27	8	30	0	30	5
2029	23	4	27	8	30	0	30	5
2030	24	4	28	8	30	0	30	5
2031	24	4	28	8	30	0	30	6
2032	24	4	28	8	30	0	30	6
2033	24	4	28	8	30	0	30	6
2034	24	4	28	8	30	0	30	6
2035	24	4	28	8	30	0	30	6
2036	24	4	28	8	30	0	30	6
2037	24	4	28	8	30	0	30	7
2038	24	4	28	8	30	0	30	7
2039	24	4	29	8	30	0	30	7
2040	24	4	29	8	30	0	30	7

Statewide Water Conservation Quantification Project
City of Lamesa Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Lamesa's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Lamesa's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The 5- and 10-year goals in Lamesa's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Lamesa with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-1.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	38	3.44	42	17	0	17	25
2016	138	3.48	141	21	0	21	121
2017	138	3.51	142	21	0	21	121
2018	138	3.55	142	25	0	25	117
2019	138	3.58	142	29	0	29	113
2020	139	3.61	142	37	0	37	105
2021	139	3.63	142	37	0	37	105
2022	139	3.64	143	37	0	37	105
2023	139	3.65	143	37	0	37	106
2024	139	3.67	143	37	0	37	106
2025	139	3.67	143	37	0	37	106
2026	140	3.69	143	37	0	37	106
2027	140	3.70	144	37	0	37	106
2028	140	3.72	144	37	0	37	106
2029	140	3.73	144	37	0	37	106
2030	140	3.74	144	37	0	37	107
2031	140	3.75	144	38	0	38	107
2032	140	3.76	144	38	0	38	107
2033	141	3.77	144	38	0	38	107
2034	141	3.78	144	38	0	38	107
2035	141	3.79	144	38	0	38	107
2036	141	3.79	145	38	0	38	107
2037	141	3.80	145	38	0	38	107
2038	141	3.81	145	38	0	38	107
2039	141	3.82	145	38	0	38	107
2040	141	3.83	145	38	0	38	107
2041	141	3.83	145	38	0	38	107
2042	141	3.83	145	38	0	38	107
2043	141	3.83	145	38	0	38	107
2044	141	3.84	145	38	0	38	107
2045	141	3.84	145	38	0	38	107
2046	141	3.84	145	38	0	38	107
2047	141	3.84	145	38	0	38	107
2048	141	3.84	145	38	0	38	107
2049	141	3.84	145	38	0	38	107
2050	141	3.85	145	38	0	38	107
2051	142	3.86	146	38	0	38	108
2052	142	3.87	146	38	0	38	108
2053	142	3.88	146	38	0	38	108
2054	143	3.89	147	38	0	38	109
2055	143	3.90	147	38	0	38	109
2056	144	3.91	148	38	0	38	109
2057	144	3.92	148	38	0	38	109
2058	144	3.93	148	39	0	39	110
2059	145	3.95	149	39	0	39	110
2060	145	3.96	149	39	0	39	110
2061	145	3.96	149	39	0	39	111
2062	146	3.97	150	39	0	39	111
2063	146	3.98	150	39	0	39	111
2064	146	3.99	150	39	0	39	111
2065	146	3.99	150	39	0	39	111
2066	147	4.00	151	39	0	39	112
2067	147	4.01	151	39	0	39	112
2068	147	4.01	151	39	0	39	112
2069	148	4.02	152	39	0	39	112
2070	148	4.03	152	39	0	39	113

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Lamesa's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	180	0	0	0
1	2015	9,429	179	6	42	36
2	2016	9,524	177	11	141	130
3	2017	9,619	175	17	142	124
4	2018	9,713	174	23	142	119
5-year Goal	2019	9,808	172	29	142	113
6	2020	9,903	170	36	142	106
7	2021	9,938	168	43	142	100
8	2022	9,973	167	50	143	93
9	2023	10,007	165	56	143	87
10-year Goal	2024	10,042	163	63	143	80

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Lamesa's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-1 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	12.00	0	0	0
1	2015	9,429	11.80	1	3.44	3
2	2016	9,524	11.60	1	3.48	2
3	2017	9,619	11.40	2	3.51	1
4	2018	9,713	11.20	3	3.55	1
5-year Goal	2019	9,808	11.00	4	3.58	(0)
6	2020	9,903	10.80	4	3.61	(1)
7	2021	9,938	10.60	5	3.63	(1)
8	2022	9,973	10.40	6	3.64	(2)
9	2023	10,007	10.20	7	3.65	(3)
10-year Goal	2024	10,042	10.00	7	3.67	(4)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of 3.44 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 26.2% increase in 2014
        ii. 67.5% increase in 2016
    b. Estimated customer demand reduction of 18.7%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	12.00	0
2015	9,427	11.00	3.44
2016	9,522	11.00	3.48
2017	9,617	11.00	3.51
2018	9,713	11.00	3.55
2019	9,808	11.00	3.58
2020	9,903	11.00	3.61
2021	9,938	11.00	3.63
2022	9,973	11.00	3.64
2023	10,007	11.00	3.65
2024	10,042	11.00	3.67

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance

a. Potentially 8.42% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)

i. Average Region O savings

ii. Specific percentage of outdoor usage unknown for your utility at this time

b. Savings could be 62 MG per year with current demand.

c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	138	3	141	62	21	0	21	183
2017	138	4	142	62	21	0	21	183
2018	138	4	142	62	25	0	25	179
2019	138	4	142	62	29	0	29	176
2020	139	4	142	62	37	0	37	168
2021	139	4	142	63	37	0	37	168
2022	139	4	143	63	37	0	37	168
2023	139	4	143	63	37	0	37	168
2024	139	4	143	63	37	0	37	168
2025	139	4	143	63	37	0	37	169
2026	140	4	143	63	37	0	37	169
2027	140	4	144	63	37	0	37	169
2028	140	4	144	63	37	0	37	169
2029	140	4	144	63	37	0	37	170
2030	140	4	144	63	37	0	37	170
2031	140	4	144	63	38	0	38	170
2032	140	4	144	63	38	0	38	170
2033	141	4	144	63	38	0	38	170
2034	141	4	144	63	38	0	38	170
2035	141	4	144	63	38	0	38	170
2036	141	4	145	63	38	0	38	170
2037	141	4	145	63	38	0	38	170
2038	141	4	145	63	38	0	38	170
2039	141	4	145	63	38	0	38	170
2040	141	4	145	63	38	0	38	171

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications.
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year.[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	138	3	141	10	21	0	21	131
2017	138	4	142	10	21	0	21	131
2018	138	4	142	10	25	0	25	127
2019	138	4	142	10	29	0	29	123
2020	139	4	142	10	37	0	37	115
2021	139	4	142	10	37	0	37	115
2022	139	4	143	10	37	0	37	115
2023	139	4	143	10	37	0	37	116
2024	139	4	143	10	37	0	37	116
2025	139	4	143	10	37	0	37	116
2026	140	4	143	10	37	0	37	116
2027	140	4	144	10	37	0	37	116
2028	140	4	144	10	37	0	37	116
2029	140	4	144	10	37	0	37	117
2030	140	4	144	10	37	0	37	117
2031	140	4	144	10	38	0	38	117
2032	140	4	144	10	38	0	38	117
2033	141	4	144	10	38	0	38	117
2034	141	4	144	10	38	0	38	117
2035	141	4	144	10	38	0	38	117
2036	141	4	145	10	38	0	38	117
2037	141	4	145	10	38	0	38	117
2038	141	4	145	10	38	0	38	117
2039	141	4	145	10	38	0	38	117
2040	141	4	145	10	38	0	38	117

Statewide Water Conservation Quantification Project
City of Levelland Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Levelland's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Levelland's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Levelland's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

---

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.

[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Levelland with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	4.7	(31)	(26)	17	0	17	(43)
2016	13.4	(31)	(18)	21	0	21	(39)
2017	13.4	(31)	(18)	21	0	21	(39)
2018	13.4	(32)	(18)	25	0	25	(43)
2019	13.5	(32)	(19)	29	0	29	(48)
2020	13.5	(32)	(19)	38	0	38	(57)
2021	13.6	(33)	(19)	36	0	36	(55)
2022	13.6	(33)	(19)	34	0	34	(53)
2023	13.7	(33)	(19)	32	0	32	(51)
2024	13.7	(33)	(20)	30	0	30	(49)
2025	13.8	(34)	(20)	28	0	28	(47)
2026	13.8	(34)	(20)	25	0	25	(45)
2027	13.8	(34)	(20)	23	0	23	(44)
2028	13.9	(34)	(20)	21	0	21	(42)
2029	13.9	(34)	(20)	19	0	19	(40)
2030	14.0	(35)	(21)	17	0	17	(38)
2031	14.0	(35)	(21)	16	0	16	(36)
2032	14.0	(35)	(21)	14	0	14	(35)
2033	14.0	(35)	(21)	12	0	12	(33)
2034	14.0	(35)	(21)	10	0	10	(31)
2035	14.1	(35)	(21)	9	0	9	(30)
2036	14.1	(35)	(21)	7	0	7	(28)
2037	14.1	(35)	(21)	5	0	5	(27)
2038	14.1	(36)	(21)	3	0	3	(25)
2039	14.1	(36)	(22)	2	0	2	(23)
2040	14.1	(36)	(22)	0	0	0	(22)
2041	14.1	(36)	(22)	0	0	0	(22)
2042	14.1	(36)	(22)	0	0	0	(22)
2043	14.1	(36)	(22)	0	0	0	(22)
2044	14.1	(36)	(22)	0	0	0	(22)
2045	14.1	(36)	(22)	0	0	0	(22)
2046	14.1	(36)	(22)	0	0	0	(22)
2047	14.1	(36)	(22)	0	0	0	(22)
2048	14.1	(36)	(22)	0	0	0	(22)
2049	14.1	(36)	(22)	0	0	0	(22)
2050	14.1	(36)	(22)	0	0	0	(22)
2051	14.2	(36)	(22)	0	0	0	(22)
2052	14.2	(36)	(22)	0	0	0	(22)
2053	14.3	(37)	(22)	0	0	0	(22)
2054	14.3	(37)	(22)	0	0	0	(22)
2055	14.4	(37)	(22)	0	0	0	(22)
2056	14.5	(37)	(23)	0	0	0	(23)
2057	14.5	(37)	(23)	0	0	0	(23)
2058	14.6	(37)	(23)	0	0	0	(23)
2059	14.6	(38)	(23)	0	0	0	(23)
2060	14.7	(38)	(23)	0	0	0	(23)
2061	14.7	(38)	(23)	0	0	0	(23)
2062	14.8	(38)	(23)	0	0	0	(23)
2063	14.8	(38)	(23)	0	0	0	(23)
2064	14.9	(38)	(23)	0	0	0	(23)
2065	14.9	(38)	(23)	0	0	0	(23)
2066	14.9	(38)	(23)	0	0	0	(23)
2067	15.0	(38)	(23)	0	0	0	(23)
2068	15.0	(39)	(23)	0	0	0	(23)
2069	15.1	(39)	(24)	0	0	0	(24)
2070	15.1	(39)	(24)	0	0	0	(24)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Levelland's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	146	0	0	0
1	2015	13,929	146	2	(26)	(28)
2	2016	14,111	145	4	(18)	(22)
3	2017	14,293	145	6	(18)	(24)
4	2018	14,475	144	8	(18)	(27)
5-year Goal	2019	14,657	144	11	(19)	(29)
6	2020	14,839	144	12	(19)	(31)
7	2021	14,934	144	13	(19)	(32)
8	2022	15,028	143	14	(19)	(34)
9	2023	15,123	143	15	(19)	(35)
10-year Goal	2024	15,217	143	17	(20)	(36)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Levelland's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	23.00	0	0	0
1	2015	13,929	22.80	1	(31)	(32)
2	2016	14,111	22.60	2	(31)	(33)
3	2017	14,293	22.40	3	(31)	(34)
4	2018	14,475	22.20	4	(32)	(36)
5-year Goal	2019	14,657	22.00	5	(32)	(37)
6	2020	14,839	21.80	6	(32)	(39)
7	2021	14,934	21.60	8	(33)	(40)
8	2022	15,028	21.40	9	(33)	(42)
9	2023	15,123	21.20	10	(33)	(43)
10-year Goal	2024	15,217	21.00	11	(33)	(44)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Loss of 31 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increases**
    a. Last rate increases:[17]
        i. 3.0% increase in 2014
        ii. 5.0% increase in 2016
    b. Estimated customer demand reduction of .8%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
    a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
    b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
    i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increase	TOTAL SAVINGS
2012		0
2013		0
2014	4.68	4.7
2015	4.70	4.7
2016	13.36	13.4
2017	13.40	13.4
2018	13.44	13.4
2019	13.49	13.5
2020	13.53	13.5
2021	13.58	13.6
2022	13.62	13.6
2023	13.66	13.7
2024	13.71	13.7
2025	13.75	13.8
2026	13.80	13.8
2027	13.84	13.8
2028	13.89	13.9
2029	13.93	13.9
2030	13.97	14.0
2031	13.99	14.0
2032	14.01	14.0
2033	14.03	14.0
2034	14.04	14.0
2035	14.06	14.1
2036	14.08	14.1
2037	14.09	14.1
2038	14.11	14.1
2039	14.13	14.1
2040	14.14	14.1
2041	14.14	14.1
2042	14.14	14.1
2043	14.13	14.1
2044	14.13	14.1
2045	14.13	14.1
2046	14.12	14.1
2047	14.12	14.1
2048	14.12	14.1
2049	14.11	14.1
2050	14.11	14.1
2051	14.17	14.2
2052	14.23	14.2
2053	14.29	14.3
2054	14.35	14.3
2055	14.41	14.4
2056	14.47	14.5
2057	14.53	14.5
2058	14.59	14.6
2059	14.65	14.6
2060	14.71	14.7
2061	14.75	14.7
2062	14.79	14.8
2063	14.83	14.8
2064	14.87	14.9
2065	14.91	14.9
2066	14.95	14.9
2067	14.99	15.0
2068	15.03	15.0
2069	15.07	15.1
2070	15.11	15.1

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	23.00	0
2015	13,929	29.00	(31)
2016	14,111	29.00	(31)
2017	14,293	29.00	(31)
2018	14,475	29.00	(32)
2019	14,657	29.00	(32)
2020	14,839	29.00	(32)
2021	14,934	29.00	(33)
2022	15,028	29.00	(33)
2023	15,123	29.00	(33)
2024	15,217	29.00	(33)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs
  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Twice-a-week Outdoor Watering Restriction Ordinance
   a. Potentially 8.42% savings of total demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and National Wildlife Federation, 2015)
      i. Average Region O savings
      ii. Specific percentage of outdoor usage unknown for your utility at this time
   b. Savings could be 66 MG per year with current demand.
   c. See Table 6-1 for potential savings from this measure compared with the city's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from 2x per Week Watering Ordinance (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Ordinance	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	13	(31)	(18)	66	21	0	21	28
2017	13	(31)	(18)	66	21	0	21	27
2018	13	(32)	(18)	67	25	0	25	23
2019	13	(32)	(19)	67	29	0	29	19
2020	14	(32)	(19)	67	38	0	38	10
2021	14	(33)	(19)	67	36	0	36	12
2022	14	(33)	(19)	67	34	0	34	14
2023	14	(33)	(19)	68	32	0	32	17
2024	14	(33)	(20)	68	30	0	30	19
2025	14	(34)	(20)	68	28	0	28	21
2026	14	(34)	(20)	68	25	0	25	23
2027	14	(34)	(20)	69	23	0	23	25
2028	14	(34)	(20)	69	21	0	21	27
2029	14	(34)	(20)	69	19	0	19	29
2030	14	(35)	(21)	69	17	0	17	31
2031	14	(35)	(21)	69	16	0	16	33
2032	14	(35)	(21)	69	14	0	14	35
2033	14	(35)	(21)	69	12	0	12	36
2034	14	(35)	(21)	70	10	0	10	38
2035	14	(35)	(21)	70	9	0	9	40
2036	14	(35)	(21)	70	7	0	7	42
2037	14	(35)	(21)	70	5	0	5	43
2038	14	(36)	(21)	70	3	0	3	45
2039	14	(36)	(22)	70	2	0	2	47
2040	14	(36)	(22)	70	0	0	0	48

2. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

- **a.** Specific utility results will vary based on portal features and frequency of customer notifications.
- **b.** Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
- **c.** Estimate assumes customers will save 10% of total annual use due to the portal
    - i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
- **d.** Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    - i. This was the most common percentage of residential use among participating utilities in this project.
    - ii. Actual customer class demand percentages will vary by utility.
- **e.** 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
- **f.** Savings are assumed to increase along with demand as connections increase each year.[19]
- **g.** See Table 6-2 for potential savings from this measure compared with the utility's WMS supply volumes targets.

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

Table 6-2. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	13	(31)	(18)	11	21	0	21	(28)
2017	13	(31)	(18)	11	21	0	21	(28)
2018	13	(32)	(18)	11	25	0	25	(33)
2019	13	(32)	(19)	11	29	0	29	(37)
2020	14	(32)	(19)	11	38	0	38	(46)
2021	14	(33)	(19)	11	36	0	36	(44)
2022	14	(33)	(19)	11	34	0	34	(42)
2023	14	(33)	(19)	11	32	0	32	(40)
2024	14	(33)	(20)	11	30	0	30	(38)
2025	14	(34)	(20)	11	28	0	28	(36)
2026	14	(34)	(20)	11	25	0	25	(35)
2027	14	(34)	(20)	11	23	0	23	(33)
2028	14	(34)	(20)	11	21	0	21	(31)
2029	14	(34)	(20)	11	19	0	19	(29)
2030	14	(35)	(21)	11	17	0	17	(27)
2031	14	(35)	(21)	11	16	0	16	(25)
2032	14	(35)	(21)	11	14	0	14	(24)
2033	14	(35)	(21)	11	12	0	12	(22)
2034	14	(35)	(21)	11	10	0	10	(20)
2035	14	(35)	(21)	11	9	0	9	(19)
2036	14	(35)	(21)	11	7	0	7	(17)
2037	14	(35)	(21)	11	5	0	5	(15)
2038	14	(36)	(21)	11	3	0	3	(14)
2039	14	(36)	(22)	11	2	0	2	(12)
2040	14	(36)	(22)	11	0	0	0	(11)

Statewide Water Conservation Quantification Project
City of Lubbock Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
  - County-Other (Rural/unincorporated areas of municipal water use)
  - Manufacturing
  - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Lubbock's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Lubbock's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Lubbock's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8 9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Lubbock with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	85	364	449	331	0	331	118
2016	87	365	452	414	0	414	38
2017	1,217	367	1,585	414	0	414	1,171
2018	1,228	369	1,597	497	0	497	1,100
2019	1,238	371	1,609	580	0	580	1,029
2020	1,248	373	1,621	745	0	745	875
2021	1,258	377	1,635	752	0	752	883
2022	1,268	381	1,649	758	0	758	891
2023	1,279	385	1,664	764	0	764	900
2024	1,289	389	1,678	770	0	770	908
2025	1,299	393	1,693	776	0	776	916
2026	1,310	398	1,707	783	0	783	925
2027	1,320	402	1,722	789	0	789	933
2028	1,331	406	1,736	795	0	795	941
2029	1,341	410	1,751	801	0	801	950
2030	1,351	414	1,765	808	0	808	958
2031	1,362	418	1,781	814	0	814	967
2032	1,373	422	1,796	820	0	820	975
2033	1,384	427	1,811	827	0	827	984
2034	1,395	431	1,826	833	0	833	993
2035	1,406	435	1,841	840	0	840	1,002
2036	1,417	439	1,856	846	0	846	1,010
2037	1,428	443	1,871	852	0	852	1,019
2038	1,439	447	1,886	859	0	859	1,028
2039	1,450	451	1,902	865	0	865	1,037
2040	1,461	456	1,917	871	0	871	1,045
2041	1,474	460	1,934	879	0	879	1,055
2042	1,487	464	1,951	887	0	887	1,064
2043	1,499	469	1,968	895	0	895	1,073
2044	1,512	473	1,986	903	0	903	1,083
2045	1,525	478	2,003	911	0	911	1,092
2046	1,538	482	2,020	919	0	919	1,101
2047	1,551	487	2,037	926	0	926	1,111
2048	1,563	491	2,054	934	0	934	1,120
2049	1,576	495	2,072	942	0	942	1,129
2050	1,589	500	2,089	950	0	950	1,139
2051	1,602	504	2,106	957	0	957	1,149
2052	1,615	508	2,123	965	0	965	1,159
2053	1,628	513	2,141	972	0	972	1,169
2054	1,641	517	2,158	979	0	979	1,179
2055	1,654	521	2,175	986	0	986	1,189
2056	1,667	525	2,192	994	0	994	1,199
2057	1,680	529	2,210	1,001	0	1,001	1,209
2058	1,693	534	2,227	1,008	0	1,008	1,219
2059	1,706	538	2,244	1,016	0	1,016	1,229
2060	1,719	542	2,261	1,023	0	1,023	1,238
2061	1,733	546	2,279	1,031	0	1,031	1,248
2062	1,746	550	2,296	1,039	0	1,039	1,257
2063	1,759	555	2,314	1,047	0	1,047	1,267
2064	1,772	559	2,331	1,055	0	1,055	1,276
2065	1,785	563	2,348	1,063	0	1,063	1,286
2066	1,799	567	2,366	1,071	0	1,071	1,295
2067	1,812	571	2,383	1,078	0	1,078	1,304
2068	1,825	575	2,400	1,086	0	1,086	1,314
2069	1,838	580	2,418	1,094	0	1,094	1,323
2070	1,851	584	2,435	1,102	0	1,102	1,333

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Lubbock's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	153	0	0	0
1	2015	249,042	152	73	449	376
2	2016	250,285	151	146	452	306
3	2017	251,528	151	220	1,585	1,364
4	2018	252,771	150	295	1,597	1,301
5-year Goal	2019	254,014	149	371	1,609	1,238
6	2020	255,257	148	447	1,621	1,173
7	2021	258,091	147	528	1,635	1,107
8	2022	260,925	147	610	1,649	1,040
9	2023	263,759	146	693	1,664	971
10-year Goal	2024	266,593	145	778	1,678	900

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Lubbock's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	15.00	0	0	0
1	2015	249,042	15.00	0	364	364
2	2016	250,285	15.00	0	365	365
3	2017	251,528	15.00	0	367	367
4	2018	252,771	15.00	0	369	369
5-year Goal	2019	254,014	15.00	0	371	371
6	2020	255,257	15.00	0	373	373
7	2021	258,091	15.00	0	377	377
8	2022	260,925	15.00	0	381	381
9	2023	263,759	15.00	0	385	385
10-year Goal	2024	266,593	15.00	0	389	389

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits
      ii. Educators teaching water conservation classes in public and private schools (K-12)
      iii. Staff making presentation on water conservation to business groups and at universities
      iv. Aggressive social media presence on Facebook, Twitter, Instagram, and Next Door educating the public about water topics.

3. **Water Loss Reduction Savings**[15]
   a. Savings of 364 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
   a. Last rate increase:[17]
      i. 3.0% increase in 2015
   b. Estimated customer demand reduction of .6%
   c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.
   e. Estimated savings of 8.42% of total utility demand (Hermitte and Mace, 2012; Sierra Club-Lone Star Chapter and the National Wildlife Federation, 2015)
   f. All savings estimates grow each year at the same rate demand figures for the

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

utility grow in the regional water plan.

5. **Outdoor landscape evaluations (residential surveys) for single family (SF) customers**
    a. 154 outdoor evaluations performed since 2016
    b. Estimated 8,000 gallons per year for each system evaluation (A&N Technical Services, 2005)
        i. Assumed 65% savings from typical indoor and outdoor survey when only outdoor watering is evaluated (Whitcomb, 2000)
    c. Approximately 22 gallons per day
    d. Greater savings during peak periods
    e. Lesser savings during off-peak periods
    f. 20% decay rate per year attributed to customer behavior (A&N Technical Services, 2005)

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	2x Watering Ordinance	Water Rate Increases	Residential Surveys	TOTAL SAVINGS
2009				0
2010				0
2011				0
2012				0
2013				0
2014				0
2015		85		85
2016		86	0.51	87
2017	1,129	87	1.13	1,217
2018	1,139	88	0.89	1,228
2019	1,149	88	0.65	1,238
2020	1,158	89	0.41	1,248
2021	1,168	90	0.16	1,258
2022	1,178	91		1,268
2023	1,187	91		1,279
2024	1,197	92		1,289
2025	1,207	93		1,299
2026	1,216	94		1,310
2027	1,226	94		1,320
2028	1,235	95		1,331
2029	1,245	96		1,341
2030	1,255	97		1,351
2031	1,265	97		1,362
2032	1,275	98		1,373
2033	1,285	99		1,384
2034	1,296	100		1,395
2035	1,306	101		1,406
2036	1,316	101		1,417
2037	1,326	102		1,428
2038	1,336	103		1,439
2039	1,346	104		1,450
2040	1,357	104		1,461
2041	1,369	105		1,474
2042	1,380	106		1,487
2043	1,392	107		1,499
2044	1,404	108		1,512
2045	1,416	109		1,525
2046	1,428	110		1,538
2047	1,440	111		1,551
2048	1,452	112		1,563
2049	1,463	113		1,576
2050	1,475	114		1,589
2051	1,487	115		1,602
2052	1,500	116		1,615
2053	1,512	116		1,628
2054	1,524	117		1,641
2055	1,536	118		1,654
2056	1,548	119		1,667
2057	1,560	120		1,680
2058	1,572	121		1,693
2059	1,584	122		1,706
2060	1,597	123		1,719
2061	1,609	124		1,733
2062	1,621	125		1,746
2063	1,633	126		1,759
2064	1,645	127		1,772
2065	1,658	128		1,785
2066	1,670	129		1,799
2067	1,682	130		1,812
2068	1,694	131		1,825
2069	1,707	131		1,838
2070	1,719	132		1,851

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction (MG)
Baseline	-	15.00	0
2015	249,042	11.00	364
2016	250,285	11.00	365
2017	251,528	11.00	367
2018	252,771	11.00	369
2019	254,014	11.00	371
2020	255,257	11.00	373
2021	258,091	11.00	377
2022	260,925	11.00	381
2023	263,759	11.00	385
2024	266,593	11.00	389

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[19]

[19] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	87	365	452	193	414	0	414	231
2017	1,217	367	1,585	194	414	0	414	1,365
2018	1,228	369	1,597	196	497	0	497	1,296
2019	1,238	371	1,609	198	580	0	580	1,226
2020	1,248	373	1,621	199	745	0	745	1,074
2021	1,258	377	1,635	201	752	0	752	1,084
2022	1,268	381	1,649	203	758	0	758	1,094
2023	1,279	385	1,664	204	764	0	764	1,104
2024	1,289	389	1,678	206	770	0	770	1,114
2025	1,299	393	1,693	208	776	0	776	1,124
2026	1,310	398	1,707	209	783	0	783	1,134
2027	1,320	402	1,722	211	789	0	789	1,144
2028	1,331	406	1,736	213	795	0	795	1,154
2029	1,341	410	1,751	214	801	0	801	1,164
2030	1,351	414	1,765	216	808	0	808	1,174
2031	1,362	418	1,781	218	814	0	814	1,184
2032	1,373	422	1,796	219	820	0	820	1,195
2033	1,384	427	1,811	221	827	0	827	1,205
2034	1,395	431	1,826	223	833	0	833	1,216
2035	1,406	435	1,841	225	840	0	840	1,226
2036	1,417	439	1,856	226	846	0	846	1,237
2037	1,428	443	1,871	228	852	0	852	1,247
2038	1,439	447	1,886	230	859	0	859	1,258
2039	1,450	451	1,902	232	865	0	865	1,268
2040	1,461	456	1,917	233	871	0	871	1,279

Statewide Water Conservation Quantification Project
City of Seminole Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Seminole's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Seminole's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Seminole's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD[7] consumption and water loss GPCD.[8] [9]
The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in million gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Seminole with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	22.6	(33)	(10)	17	0	17	(27)
2016	27.2	(32)	(5)	21	0	21	(26)
2017	27.5	(32)	(5)	21	0	21	(26)
2018	27.8	(32)	(4)	25	0	25	(29)
2019	28.0	(31)	(3)	30	0	30	(33)
2020	28.3	(31)	(3)	38	0	38	(41)
2021	28.6	(31)	(3)	39	0	39	(41)
2022	28.9	(32)	(3)	39	0	39	(42)
2023	29.1	(32)	(3)	39	0	39	(42)
2024	29.4	(32)	(3)	40	0	40	(43)
2025	29.7	(33)	(3)	40	0	40	(43)
2026	29.9	(33)	(3)	40	0	40	(44)
2027	30.2	(34)	(3)	41	0	41	(44)
2028	30.5	(34)	(3)	41	0	41	(45)
2029	30.7	(34)	(3)	42	0	42	(45)
2030	31.0	(35)	(4)	42	0	42	(46)
2031	31.3	(35)	(4)	42	0	42	(46)
2032	31.7	(35)	(4)	43	0	43	(47)
2033	32.0	(36)	(4)	43	0	43	(47)
2034	32.3	(36)	(4)	44	0	44	(48)
2035	32.7	(37)	(4)	44	0	44	(48)
2036	33.0	(37)	(4)	45	0	45	(49)
2037	33.3	(37)	(4)	45	0	45	(49)
2038	33.7	(38)	(4)	45	0	45	(50)
2039	34.0	(38)	(4)	46	0	46	(50)
2040	34.3	(39)	(4)	46	0	46	(51)
2041	34.7	(39)	(4)	47	0	47	(51)
2042	35.1	(40)	(5)	47	0	47	(52)
2043	35.5	(40)	(5)	48	0	48	(52)
2044	35.8	(40)	(5)	48	0	48	(53)
2045	36.2	(41)	(5)	49	0	49	(54)
2046	36.6	(41)	(5)	49	0	49	(54)
2047	37.0	(42)	(5)	50	0	50	(55)
2048	37.3	(42)	(5)	50	0	50	(55)
2049	37.7	(43)	(5)	51	0	51	(56)
2050	38.1	(43)	(5)	51	0	51	(57)
2051	38.4	(44)	(5)	52	0	52	(57)
2052	38.7	(44)	(5)	52	0	52	(57)
2053	39.0	(44)	(5)	53	0	53	(58)
2054	39.3	(45)	(5)	53	0	53	(58)
2055	39.6	(45)	(5)	54	0	54	(59)
2056	39.9	(45)	(5)	54	0	54	(59)
2057	40.2	(46)	(5)	54	0	54	(60)
2058	40.5	(46)	(5)	55	0	55	(60)
2059	40.8	(46)	(5)	55	0	55	(61)
2060	41.1	(47)	(6)	56	0	56	(61)
2061	41.4	(47)	(6)	56	0	56	(62)
2062	41.8	(47)	(6)	57	0	57	(62)
2063	42.1	(48)	(6)	57	0	57	(63)
2064	42.4	(48)	(6)	57	0	57	(63)
2065	42.7	(48)	(6)	58	0	58	(64)
2066	43.0	(49)	(6)	58	0	58	(64)
2067	43.4	(49)	(6)	59	0	59	(65)
2068	43.7	(50)	(6)	59	0	59	(65)
2069	44.0	(50)	(6)	60	0	60	(65)
2070	44.3	(50)	(6)	60	0	60	(66)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Seminole's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	7,257	268	0	0	0
1	2015	7,448	265	7	(10)	(17)
2	2016	7,379	263	14	(5)	(19)
3	2017	7,310	260	21	(5)	(25)
4	2018	7,240	258	27	(4)	(31)
5-year Goal	2019	7,171	255	34	(3)	(37)
6	2020	7,102	252	41	(3)	(44)
7	2021	7,181	249	49	(3)	(52)
8	2022	7,260	247	57	(3)	(60)
9	2023	7,339	244	65	(3)	(68)
10-year Goal	2024	7,418	241	73	(3)	(76)

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Seminole's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	7,257	13.00	0	0	0
1	2015	7,448	25.00	(33)	(33)	0
2	2016	7,379	24.80	(32)	(32)	(1)
3	2017	7,310	24.60	(31)	(32)	(1)
4	2018	7,240	24.40	(30)	(32)	(2)
5-year Goal	2019	7,171	12.00	3	(31)	(34)
6	2020	7,102	11.80	3	(31)	(34)
7	2021	7,181	11.60	4	(31)	(35)
8	2022	7,260	11.40	4	(32)	(36)
9	2023	7,339	11.20	5	(32)	(37)
10-year Goal	2024	7,418	11.00	5	(32)	(38)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
   a. Loss of 33 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Conservation Pricing and Water Rate Increases**
   a. Tiered rate structure in place saves approximately 2.5% of total demand
   b. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; TWDB, 2013)

5. **Automatic Meter Reading (AMR)/Advanced Metering Infrastructure (AMI)**
   a. These metering systems can save water in a number of ways, including from water loss reduction through improved leak detection.
   b. All water loss reduction savings associated with this activity are detailed in Section 5, which assessed utility baseline water loss GPCD and most recently reported water loss GPCD to determine water savings.
   c. For estimated water savings that could be increased by implementing meter data management (MDM) and customer engagement portal applications, refer to Section 6 of this report.
      i. With these additional applications, water savings can be achieved through changed customer behavior and other real-time actions that go beyond water loss reduction.

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increase	TOTAL SAVINGS
2012			0
2013			0
2014	18.0	4.3	22.4
2015	18.2	4.4	22.6
2016	18.4	8.8	27.2
2017	18.6	8.9	27.5
2018	18.8	9.0	27.8
2019	18.9	9.1	28.0
2020	19.1	9.2	28.3
2021	19.3	9.3	28.6
2022	19.5	9.4	28.9
2023	19.7	9.4	29.1
2024	19.9	9.5	29.4
2025	20.0	9.6	29.7
2026	20.2	9.7	29.9
2027	20.4	9.8	30.2
2028	20.6	9.9	30.5
2029	20.8	10.0	30.7
2030	20.9	10.1	31.0
2031	21.2	10.2	31.3
2032	21.4	10.3	31.7
2033	21.6	10.4	32.0
2034	21.8	10.5	32.3
2035	22.1	10.6	32.7
2036	22.3	10.7	33.0
2037	22.5	10.8	33.3
2038	22.7	10.9	33.7
2039	23.0	11.0	34.0
2040	23.2	11.1	34.3
2041	23.5	11.3	34.7
2042	23.7	11.4	35.1
2043	24.0	11.5	35.5
2044	24.2	11.6	35.8
2045	24.5	11.7	36.2
2046	24.7	11.9	36.6
2047	25.0	12.0	37.0
2048	25.2	12.1	37.3
2049	25.5	12.2	37.7
2050	25.7	12.4	38.1
2051	26.0	12.5	38.4
2052	26.2	12.6	38.7
2053	26.4	12.7	39.0
2054	26.6	12.8	39.3
2055	26.8	12.8	39.6
2056	27.0	12.9	39.9
2057	27.2	13.0	40.2
2058	27.4	13.1	40.5
2059	27.6	13.2	40.8
2060	27.8	13.3	41.1
2061	28.0	13.4	41.4
2062	28.2	13.5	41.8
2063	28.4	13.6	42.1
2064	28.7	13.8	42.4
2065	28.9	13.9	42.7
2066	29.1	14.0	43.0
2067	29.3	14.1	43.4
2068	29.5	14.2	43.7
2069	29.7	14.3	44.0
2070	29.9	14.4	44.3

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline		13.00	0
2015	7,448	25.00	(33)
2016	7,379	25.00	(32)
2017	7,310	25.00	(32)
2018	7,240	25.00	(32)
2019	7,171	25.00	(31)
2020	7,102	25.00	(31)
2021	7,181	25.00	(31)
2022	7,260	25.00	(32)
2023	7,339	25.00	(32)
2024	7,418	25.00	(32)

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
  i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
  i. This was the most common percentage of residential use among participating utilities in this project.
  ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	27	(32)	(5)	10	21	0	21	(16)
2017	28	(32)	(5)	10	21	0	21	(16)
2018	28	(32)	(4)	10	25	0	25	(19)
2019	28	(31)	(3)	10	30	0	30	(23)
2020	28	(31)	(3)	10	38	0	38	(31)
2021	29	(31)	(3)	10	39	0	39	(31)
2022	29	(32)	(3)	10	39	0	39	(31)
2023	29	(32)	(3)	11	39	0	39	(32)
2024	29	(32)	(3)	11	40	0	40	(32)
2025	30	(33)	(3)	11	40	0	40	(33)
2026	30	(33)	(3)	11	40	0	40	(33)
2027	30	(34)	(3)	11	41	0	41	(33)
2028	30	(34)	(3)	11	41	0	41	(34)
2029	31	(34)	(3)	11	42	0	42	(34)
2030	31	(35)	(4)	11	42	0	42	(34)
2031	31	(35)	(4)	11	42	0	42	(35)
2032	32	(35)	(4)	11	43	0	43	(35)
2033	32	(36)	(4)	12	43	0	43	(36)
2034	32	(36)	(4)	12	44	0	44	(36)
2035	33	(37)	(4)	12	44	0	44	(36)
2036	33	(37)	(4)	12	45	0	45	(37)
2037	33	(37)	(4)	12	45	0	45	(37)
2038	34	(38)	(4)	12	45	0	45	(37)
2039	34	(38)	(4)	12	46	0	46	(38)
2040	34	(39)	(4)	12	46	0	46	(38)

2. Water Rate Increase
    a. For every 10% increase, estimated savings could be 2% of utility total demand.
    b. Approximately 15 MG of savings per year with current demand
    c. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; Whitcomb, 1999)
    d. See Table 6-2 for potential savings from this measure compared with the utility's conservation goals.

[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

Table 6-2. Current Savings + Potential Savings from 10% Water Rate Increase (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from Water Rate Increase	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	27	(32)	(5)	15	21	0	21	(12)
2017	28	(32)	(5)	15	21	0	21	(11)
2018	28	(32)	(4)	15	25	0	25	(14)
2019	28	(31)	(3)	15	30	0	30	(18)
2020	28	(31)	(3)	15	38	0	38	(26)
2021	29	(31)	(3)	15	39	0	39	(26)
2022	29	(32)	(3)	16	39	0	39	(26)
2023	29	(32)	(3)	16	39	0	39	(27)
2024	29	(32)	(3)	16	40	0	40	(27)
2025	30	(33)	(3)	16	40	0	40	(27)
2026	30	(33)	(3)	16	40	0	40	(28)
2027	30	(34)	(3)	16	41	0	41	(28)
2028	30	(34)	(3)	16	41	0	41	(28)
2029	31	(34)	(3)	17	42	0	42	(29)
2030	31	(35)	(4)	17	42	0	42	(29)
2031	31	(35)	(4)	17	42	0	42	(29)
2032	32	(35)	(4)	17	43	0	43	(29)
2033	32	(36)	(4)	17	43	0	43	(30)
2034	32	(36)	(4)	17	44	0	44	(30)
2035	33	(37)	(4)	18	44	0	44	(30)
2036	33	(37)	(4)	18	45	0	45	(31)
2037	33	(37)	(4)	18	45	0	45	(31)
2038	34	(38)	(4)	18	45	0	45	(31)
2039	34	(38)	(4)	18	46	0	46	(32)
2040	34	(39)	(4)	19	46	0	46	(32)

Statewide Water Conservation Quantification Project
City of Silverton Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares Silverton's current water conservation activities and their quantified savings to two metrics: 1) Region O Water Plan's (Texas Water Development Board, 2016m) recommended WMS supply volumes for municipal conservation, and 2) Silverton's own five- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.[5]

The five- and 10-year goals in Silverton's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[6] are expressed in decreasing total GPCD [7] consumption and water loss GPCD.[8] [9]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's

[5] Some regional water plans separate this strategy volume into a volume for water conservation and a volume for water loss reduction for each decade. The total strategy volume is the sum of both.
[6] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.
[7] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365
[8] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.
[9] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[10] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for Silverton with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

<u>Actual Current Conservation Activity Savings</u> – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[11] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [12] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[11] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[12] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	1.62	0.28	1.9	0.9	0	0.9	1.0
2016	1.62	0.28	1.9	1.1	0	1.1	0.8
2017	1.61	0.28	1.9	1.1	0	1.1	0.8
2018	1.61	0.28	1.9	1.3	0	1.3	0.6
2019	1.61	0.27	1.9	1.5	0	1.5	0.4
2020	1.60	0.27	1.9	2.0	0	2.0	(0.1)
2021	1.60	0.27	1.9	2.0	0	2.0	(0.1)
2022	1.59	0.27	1.9	2.0	0	2.0	(0.1)
2023	1.59	0.27	1.9	2.0	0	2.0	(0.1)
2024	1.59	0.27	1.9	2.0	0	2.0	(0.1)
2025	1.58	0.27	1.9	2.0	0	2.0	(0.1)
2026	1.58	0.27	1.8	2.0	0	2.0	(0.1)
2027	1.57	0.27	1.8	2.0	0	2.0	(0.1)
2028	1.57	0.27	1.8	2.0	0	2.0	(0.1)
2029	1.57	0.27	1.8	2.0	0	2.0	(0.1)
2030	1.56	0.27	1.8	2.0	0	2.0	(0.1)
2031	1.56	0.27	1.8	1.8	0	1.8	0.0
2032	1.56	0.27	1.8	1.7	0	1.7	0.1
2033	1.55	0.27	1.8	1.6	0	1.6	0.3
2034	1.55	0.27	1.8	1.4	0	1.4	0.4
2035	1.54	0.27	1.8	1.3	0	1.3	0.5
2036	1.54	0.27	1.8	1.2	0	1.2	0.6
2037	1.54	0.27	1.8	1.0	0	1.0	0.8
2038	1.53	0.27	1.8	0.9	0	0.9	0.9
2039	1.53	0.27	1.8	0.8	0	0.8	1.0
2040	1.53	0.27	1.8	0.7	0	0.7	1.1
2041	1.52	0.27	1.8	0.7	0	0.7	1.1
2042	1.52	0.27	1.8	0.7	0	0.7	1.1
2043	1.52	0.27	1.8	0.7	0	0.7	1.1
2044	1.52	0.27	1.8	0.7	0	0.7	1.1
2045	1.52	0.27	1.8	0.7	0	0.7	1.1
2046	1.52	0.27	1.8	0.7	0	0.7	1.1
2047	1.52	0.27	1.8	0.7	0	0.7	1.1
2048	1.52	0.27	1.8	0.7	0	0.7	1.1
2049	1.51	0.27	1.8	0.7	0	0.7	1.1
2050	1.51	0.27	1.8	0.7	0	0.7	1.1
2051	1.51	0.27	1.8	0.7	0	0.7	1.1
2052	1.51	0.27	1.8	0.7	0	0.7	1.1
2053	1.51	0.27	1.8	0.7	0	0.7	1.1
2054	1.51	0.27	1.8	0.7	0	0.7	1.1
2055	1.51	0.27	1.8	0.7	0	0.7	1.1
2056	1.51	0.27	1.8	0.7	0	0.7	1.1
2057	1.51	0.27	1.8	0.7	0	0.7	1.1
2058	1.51	0.27	1.8	0.7	0	0.7	1.1
2059	1.51	0.27	1.8	0.7	0	0.7	1.1
2060	1.51	0.27	1.8	0.7	0	0.7	1.1
2061	1.51	0.27	1.8	0.7	0	0.7	1.1
2062	1.51	0.27	1.8	0.7	0	0.7	1.1
2063	1.51	0.27	1.8	0.7	0	0.7	1.1
2064	1.51	0.27	1.8	0.7	0	0.7	1.1
2065	1.51	0.27	1.8	0.7	0	0.7	1.1
2066	1.51	0.27	1.8	0.7	0	0.7	1.1
2067	1.51	0.27	1.8	0.7	0	0.7	1.1
2068	1.51	0.27	1.8	0.7	0	0.7	1.1
2069	1.51	0.27	1.8	0.7	0	0.7	1.1
2070	1.51	0.27	1.8	0.7	0	0.7	1.1

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how Silverton's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[13] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	121	0	0	0
1	2015	779	123	(1)	2	2
2	2016	771	125	(1)	2	3
3	2017	764	126	(2)	2	3
4	2018	756	128	(2)	2	4
5-year Goal	2019	749	130	(2)	2	4
6	2020	741	129	(2)	2	4
7	2021	741	128	(2)	2	4
8	2022	741	127	(2)	2	3
9	2023	741	126	(1)	2	3
10-year Goal	2024	741	125	(1)	2	3

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how Silverton's most recent water loss audit compares with five- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[14] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	10.00	0	0	0
1	2015	779	9.60	0.1	0.28	0.2
2	2016	771	9.20	0.2	0.28	0.1
3	2017	764	8.80	0.3	0.28	(0.1)
4	2018	756	8.40	0.4	0.28	(0.2)
5-year Goal	2019	749	8.00	0.5	0.27	(0.3)
6	2020	741	7.80	0.6	0.27	(0.3)
7	2021	741	7.60	0.6	0.27	(0.4)
8	2022	741	7.40	0.7	0.27	(0.4)
9	2023	741	7.20	0.8	0.27	(0.5)
10-year Goal	2024	741	7.00	0.8	0.27	(0.5)

[14] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility’s water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
    a. Easy-to-use website with conservation tips and water rates
    b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
    a. The utility engages the public in many ways including:
        i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[15]
    a. Savings of .28 MG annually in 2015
    b. Water loss reduction savings = the difference between a utility's baseline[16] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
    c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
    d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
    a. Last rate increase:[17]
        i. 7.0% increase in 2015
    b. Estimated customer demand reduction of 1.4%
    c. Savings is cumulative and based on more than one source[18] (U.S. EPA, 1998; Whitcomb, 1999)
    d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

5. **Conservation Pricing and Water Rate Increases**
    a. Tiered rate structure in place saves approximately 2.5% of total demand
    b. Savings is cumulative and based on more than one source[19] (U.S. EPA, 1998; TWDB, 2013)

---

[15] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[16] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[17] Correspondence with utility staff.
[18] We estimate 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, we can determine the savings for lower or higher percentage increases.
[19] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Conservation Pricing	Water Rate Increase	TOTAL SAVINGS
2009			0
2010			0
2011			0
2012			0
2013			0
2014	1.04		1.0
2015	1.04	0.58	1.6
2016	1.04	0.58	1.6
2017	1.03	0.58	1.6
2018	1.03	0.58	1.6
2019	1.03	0.58	1.6
2020	1.03	0.57	1.6
2021	1.02	0.57	1.6
2022	1.02	0.57	1.6
2023	1.02	0.57	1.6
2024	1.02	0.57	1.6
2025	1.01	0.57	1.6
2026	1.01	0.57	1.6
2027	1.01	0.57	1.6
2028	1.01	0.56	1.6
2029	1.00	0.56	1.6
2030	1.00	0.56	1.6
2031	1.00	0.56	1.6
2032	1.00	0.56	1.6
2033	0.99	0.56	1.6
2034	0.99	0.56	1.5
2035	0.99	0.55	1.5
2036	0.99	0.55	1.5
2037	0.99	0.55	1.5
2038	0.98	0.55	1.5
2039	0.98	0.55	1.5
2040	0.98	0.55	1.5
2041	0.98	0.55	1.5
2042	0.98	0.55	1.5
2043	0.98	0.55	1.5
2044	0.97	0.55	1.5
2045	0.97	0.55	1.5
2046	0.97	0.54	1.5
2047	0.97	0.54	1.5
2048	0.97	0.54	1.5
2049	0.97	0.54	1.5
2050	0.97	0.54	1.5
2051	0.97	0.54	1.5
2052	0.97	0.54	1.5
2053	0.97	0.54	1.5
2054	0.97	0.54	1.5
2055	0.97	0.54	1.5
2056	0.97	0.54	1.5
2057	0.97	0.54	1.5
2058	0.97	0.54	1.5
2059	0.97	0.54	1.5
2060	0.97	0.54	1.5
2061	0.97	0.54	1.5
2062	0.97	0.54	1.5
2063	0.97	0.54	1.5
2064	0.97	0.54	1.5
2065	0.97	0.54	1.5
2066	0.97	0.54	1.5
2067	0.97	0.54	1.5
2068	0.97	0.54	1.5
2069	0.97	0.54	1.5
2070	0.97	0.54	1.5

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	10.00	0
2015	779	9.00	0.28
2016	771	9.00	0.28
2017	764	9.00	0.28
2018	756	9.00	0.28
2019	749	9.00	0.27
2020	741	9.00	0.27
2021	741	9.00	0.27
2022	741	9.00	0.27
2023	741	9.00	0.27
2024	741	9.00	0.27

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
  - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

  - Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
   i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
   i. This was the most common percentage of residential use among participating utilities in this project.
   ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[20]

[20] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	2	0	2	1	1	0	1	1
2017	2	0	2	1	1	0	1	1
2018	2	0	2	1	1	0	1	1
2019	2	0	2	1	2	0	2	1
2020	2	0	2	1	2	0	2	0
2021	2	0	2	1	2	0	2	0
2022	2	0	2	1	2	0	2	0
2023	2	0	2	1	2	0	2	0
2024	2	0	2	1	2	0	2	0
2025	2	0	2	1	2	0	2	0
2026	2	0	2	1	2	0	2	0
2027	2	0	2	1	2	0	2	0
2028	2	0	2	1	2	0	2	0
2029	2	0	2	1	2	0	2	0
2030	2	0	2	1	2	0	2	0
2031	2	0	2	1	2	0	2	1
2032	2	0	2	1	2	0	2	1
2033	2	0	2	1	2	0	2	1
2034	2	0	2	1	1	0	1	1
2035	2	0	2	1	1	0	1	1
2036	2	0	2	1	1	0	1	1
2037	2	0	2	1	1	0	1	1
2038	2	0	2	1	1	0	1	1
2039	2	0	2	1	1	0	1	2
2040	2	0	2	1	1	0	1	2

Region P Individual Reports

Statewide Water Conservation Quantification Project
City of El Campo Report • 2017

1 Introduction

In Texas' 2017 State Water Plan, municipal water conservation is projected to meet 9.6 percent[1] of the state's future water needs by 2070. According to the 16 regional water plans that comprise the state water plan, this is expected to be achieved through a variety of measures such as installation of water efficient plumbing fixtures, water conservation pricing structures, water system audits, landscape irrigation ordinances, as well as other water conservation activities. The 9.6 percent is "in addition to the estimated share of future passive conservation savings from plumbing codes and water efficiency standards, which are embedded in municipal water demand projections" (Texas Water Development Board, 2017).

In 2015, the Texas Legislature appropriated funds to the Texas Water Development Board (TWDB) to fund a research project principally charged with quantitatively determining the savings of municipal water conservation activities being implemented in relation to the recommended conservation goals (supply volumes) in the State Water Plan. As part of the project, individual reports were completed for all participating utilities.

With this report, utilities will benefit by receiving a clear and concise picture of its water conservation goals alongside estimated savings from quantifiable activities. In the event that current activity savings may not be able to reach long-term goals, this report offers suggestions on how utilities can reach water conservation goals with activities that are effective, easily adopted, have widespread appeal, and are quantifiable.

2 Municipal Conservation Terminology and Review of Methodology Used by Regional Planners

To make use of the results of this study, it is important to understand several key terms used in the water planning process.

What is a water user group?

In this report, a water user group (WUG) refers to a retail water provider in the form a city, municipal utility district, water control and improvement district, special utility district, water supply corporation, fresh water supply district, or other type of water utility. The TWDB further defines WUGs as one of the following (Texas Water Development Board, 2016b):

- Cities and towns with a population of 500 or more
- Non-city utilities providing more than 280 acre-feet per year per year of water for municipal use
- Collective reporting units (CRUs) consisting of grouped utilities having a common association

[1] Equal to 811,224 acre-feet per year in conservation savings.

- County-Wide WUGs:
    - County-Other (Rural/unincorporated areas of municipal water use)
    - Manufacturing
    - Steam electric power generation

What is a recommended water management strategy?

A recommended water management strategy (WMS) is a measure that will help ensure WUGs have adequate water supplies for their end users well into the future. WMS examples include river diversions, groundwater use, reservoir and aquifer development, and irrigation conservation. When WMS is referred to in this report, it refers only to municipal conservation, which may include water loss reduction as a part of the same strategy.

What is a WMS supply volume?

A WMS supply volume is the amount of water that a given strategy is expected to yield each decade in the planning period if carried out by the WUG. In this report, a WMS supply volume is the amount of water recommended to come from municipal water conservation.

Some regional water plans separate this strategy's supply volume into a volume for municipal water conservation and a volume for water loss reduction for each decade. The total strategy supply volume is the sum of both. A regional water plan may also refer to "advanced conservation" as part of this strategy. Advanced conservation usually indicates that the volume could be achieved through a more robust mix of conservation activities described in the plan.

2.1 Regional Planning Group Approach to Determining Supply Volumes

Each regional water planning group (RWPG) is responsible for producing its own individual plan that, if executed, will provide sufficient water to its WUGs throughout a 50-year planning period. These plans are completed in five-year cycles, with the most recent edition being completed in 2016. The 2016 regional plans make up the 2017 State Water Plan, which sets out WMS supply volumes for the years 2020 through 2070.

The decadal WMS supply volumes for municipal conservation were established by each of the RWPGs in much the same manner. The RWPGs generally followed the guidelines of the Texas Legislature's Water Conservation Implementation Task Force on the pace utilities should target to reduce gallons per capita per day (GPCD)[2] consumption levels.

The targeted reductions used by most regions follow this formula:

- For municipal WUGs with water use of 140 GPCD and greater, the goal is to reduce per capita water use by one percent per year until the level of 140 GPCD is reached,

[2] Regional water planning GPCD is defined as the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume (Texas Water Development Board, 2012).

after which, the goal is to reduce per capita water use by one-fourth percent per year for the remainder of the planning period (Texas Water Development Board, 2016j).

The yearly reductions in GPCD for a given WUG are then converted into recommended supply volumes in acre-feet per year for each decade as the reductions in consumption continue. Some regions reduce GPCD by slightly different percentages before and after the 140 GPCD threshold, some do not apply further reductions in GPCD for WUGs once they reach 140 GPCD, while others recommend only "advanced conservation" activities once WUGs meet 140 GPCD.

2.2 Methodology

In order to complete a uniform quantification process, the first engagement was with utilities that agreed to participate and collected as much relevant data as possible. These data included, among many others, historical GPCD consumption figures, advanced metering infrastructure (AMI) specifications, and detailed feedback on each conservation activity being implemented. Personal interviews focused on determining when and to what extent these activities were being employed, as well as assessing plans to continue such conservation. Examples of frequently implemented activities include tiered water rate conservation pricing, strategic water rate increases, outdoor irrigation audits and ordinances, and rain barrel distribution.

Subsequently, each utility's conservation activities were quantified through several different means, including evidence-based studies, utility field results and savings determinations, manufacturer guarantees, water loss audits, TWDB studies, and other information that assigned a savings value to the activity's implementation.

Every conservation activity studied and quantified has a gallons-per-year estimate, useful life, and decay rate (if applicable) associated with it. Some activities' savings are projected to grow as demand grows over time, while some savings are constant each year and subside once useful life has run its course. For expanded methodology and details on studies and formulas used to determine activity savings, refer to Section 6 of the State Report included as part of this document.

Once analyzed, the resulting savings estimates from each utility were compared with the recommended WMS supply volumes in its respective regional plan to determine if the savings met, exceeded, or fell short of those volumes. Individual utility savings were aggregated to compare with regional volumes, and regional savings were aggregated to compare with state volumes.

It is important to note that this report quantified activity savings—not including water loss reduction—for the WMS supply volume comparison dating back to 2012. The reason for this is, with a few exceptions, the regional planners used 2011 as the base year for establishing potential WMS supply volumes.[3] In addition, any conservation savings achieved through 2011 are assumed to be accounted for in the regional water planning GPCD for that year.[4] Thus, quantifying from 2012 and forward is the most accurate way to determine if utilities are meeting

[3] Confirmed via personal communication with Region C, H, K, and L Plan consultants.
[4] It was established with TWDB planning staff that 2011 GPCD levels were chosen because they represented the most current water use and conservation patterns at the time.

the recommended conservation volumes in the regional plans. This assumption is by no means 100 percent accurate, however. Some previously implemented activities' savings persist into future years beyond this starting point, while some activities' savings have ceased. One year's GPCD will not necessarily include all savings yielded by conservation activities that came before it, but the quantification assessment must have a starting point.

2.3 Quantifiable Savings

The key to the project being useful and reliable is that the results from year to year are measurable. Quantifying conservation activities that can be accurately measured provides greater certainty and better planning for all stakeholders.

While many utilities are engaged in a variety of conservation activities, not all can currently be properly measured. Some examples of these activities include education initiatives, website and social media engagement, and enforcement for water waste. That does not mean these measures are not essential. Education of consumers, for example, is a fundamental activity that makes all others effective, but little hard data exists to quantify the results of education alone.

In addition, the work of conservation coordinators can have a particularly significant effect on the savings of all other activities, but the specific savings attributed to that staff role is difficult to quantify.

3 Results

This report compares El Campo's current water conservation activities and their quantified savings to two metrics: 1) Region P Water Plan's (Texas Water Development Board, 2016n) recommended WMS supply volumes for municipal conservation, and 2) El Campo's own 5- and 10-year goals as established in its most recent water conservation plan submitted to the TWDB.

The WMS supply volumes for municipal water conservation are laid out by decade (2020 – 2070) in the regional water plans to serve as benchmarks for what each utility could achieve via that strategy during a 50-year planning period.

The 5- and 10-year goals in El Campo's most recent water conservation plan are established by the utility as realistic targets for reducing consumption over that timeframe. These reductions[5] are expressed in decreasing total GPCD [6] consumption and water loss GPCD.[7] [8]

The estimated savings in Tables 3-1 through 3-3 indicate the best information available as provided by utility staff. Some ongoing activities may not be known and are within a utility's service area are implemented on a micro-scale that may not be quantified. Individual households and businesses may be implementing conservation measures that are unknown and therefore cannot be included in the report.

---

[5] Occasionally, some utilities expect consumption to increase due to various reasons, such as an incoming industrial presence expected to raise consumption figures for the entire service area.

[6] As defined in TWDB water conservation annual reports: (Total Gallons in System ÷ Permanent Population) ÷ 365

[7] These plans also have targets for residential GPCD and water loss as a percentage (rather than GPCD), but this report does not address those goals.

[8] As defined in annual TWDB water loss audits: (Total Water Loss ÷ Permanent Population) ÷ 365

Explanation of approach to assessing water loss reduction savings

Water loss reduction savings are defined as the volume of water participating utilities are realizing from their water loss mitigation efforts. For this report, this value is the difference between each individual utility's baseline[9] for water loss GPCD and its most recent water loss GPCD reported in 2015 water loss audits on file with TWDB. Savings from all water loss reduction efforts—including pipe replacements and leak repair—are assumed to be included in this comparison to a utility's baseline.

Note that because a single year (2015) value was used for comparison, it is possible that the 2015 value could be anomalous due to a number of events that may have occurred that year, such as a water main break, a particularly wet year, or a robust effort by the utility to curtail water loss. This will distort future savings figures that were carried forward in the study because water loss will inevitably increase or decrease in later years.

Ideally, using a rolling five-year average in the calculation would correct such anomalies. However, there was insufficient data to do that for every utility. The approach was to use the most complete water loss data possible, which was represented by the 2015 water loss audit. This problem will be further minimized, as continued data collection will allow five-year averages to be calculated for a majority of utilities.

In this way, water loss savings estimates are different from all other activity savings estimates in the project. Whether savings were positive or negative depended on where individual utilities established their own baselines or where their five-year average started, and what water loss GPCD value was reported in 2015.

3.1 Current Savings Compared to Conservation WMS Supply Volume (in Million Gallons) in Regional Water Plan

Table 3-1 shows the 2070 outlook for El Campo with the utility's yearly recommended WMS supply volume in million gallons (MG) alongside its water savings from implemented activities, including from water loss reduction. These activities and their associated savings are covered in greater detail in Sections 4 and 5.

Starting in 2015, this table compares all quantified conservation activity and the recommended conservation WMS supply volume for the planning period. The following definitions pair with the column headers in Table 3-1.

Actual Current Conservation Activity Savings – All quantified activities currently being performed by the utility, *excluding* savings from water loss reduction. The regional planners used 2011 GPCD as the baseline for determining future conservation WMS supply volumes, therefore the study quantifies utility savings starting in 2012 for this comparison. The summary of these savings can be referenced in Table 5-1.

[9] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

Actual Water Loss Reduction Savings (as of 2015) – The difference between the baseline[10] for water loss GPCD and most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. [11] The summary of these savings can be referenced in Table 5-2.

Total Savings from All Conservation Activity – Actual Current Conservation Activity Savings plus Actual Water Loss Reduction Savings (as of 2015).

Conservation WMS Volume – The recommended municipal water conservation supply volume in the regional plan for the decades ranging from 2020 to 2070. These volumes are converted to MG from the values listed in the plan in acre-feet and then calculated in annual increments.

Water Loss Reduction WMS Volume – Some regional water plans have a separate WMS volume for water conservation and for water loss reduction for each decade. If a WUG's regional plan has a WMS volume for water loss reduction, this column will have values other than zero.

Total Yearly WMS Volume – The sum of the Conservation WMS Volume and Water Loss Reduction WMS Volume.

Over (Short) – The amount that the utility's Total Savings from All Conservation Activity (since 2012), is over or below the Total Yearly WMS Volume in the regional water plan. If the amount falls below the WMS volume, it will appear in parentheses.

[10] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.
[11] If water loss GPCD has increased from the utility's baseline or historic five-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.

Table 3-1. Current Savings Compared to Conservation WMS Supply Volume (MG) in Regional Water Plan.

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2015	32	13.2	45	16	0	16	29
2016	32	13.2	45	20	0	20	25
2017	32	13.2	45	20	0	20	25
2018	32	13.2	45	24	0	24	22
2019	32	13.3	45	28	0	28	18
2020	32	13.3	45	36	0	36	10
2021	32	13.3	45	38	0	38	8
2022	32	13.4	46	39	0	39	6
2023	32	13.4	46	41	0	41	4
2024	32	13.5	46	43	0	43	2
2025	32	13.6	46	45	0	45	1
2026	32	13.6	46	47	0	47	(1)
2027	33	13.7	46	49	0	49	(3)
2028	33	13.8	46	51	0	51	(5)
2029	33	13.8	47	53	0	53	(7)
2030	33	13.9	47	55	0	55	(9)
2031	33	13.9	47	58	0	58	(11)
2032	33	14.0	47	60	0	60	(13)
2033	33	14.0	47	62	0	62	(15)
2034	33	14.1	47	64	0	64	(17)
2035	33	14.1	47	66	0	66	(19)
2036	33	14.2	47	69	0	69	(21)
2037	33	14.2	47	71	0	71	(23)
2038	33	14.3	47	73	0	73	(25)
2039	33	14.3	48	75	0	75	(27)
2040	33	14.4	48	77	0	77	(30)
2041	33	14.4	48	80	0	80	(33)
2042	33	14.5	48	83	0	83	(36)
2043	33	14.5	48	87	0	87	(39)
2044	34	14.5	48	90	0	90	(42)
2045	34	14.6	48	93	0	93	(45)
2046	34	14.6	48	96	0	96	(48)
2047	34	14.7	48	99	0	99	(51)
2048	34	14.7	49	102	0	102	(54)
2049	34	14.8	49	105	0	105	(57)
2050	34	14.8	49	109	0	109	(60)
2051	34	14.8	49	108	0	108	(60)
2052	34	14.9	49	108	0	108	(59)
2053	34	14.9	49	108	0	108	(59)
2054	34	15.0	49	108	0	108	(59)
2055	34	15.0	49	108	0	108	(59)
2056	34	15.0	49	108	0	108	(58)
2057	35	15.1	50	108	0	108	(58)
2058	35	15.1	50	107	0	107	(58)
2059	35	15.2	50	107	0	107	(58)
2060	35	15.2	50	107	0	107	(57)
2061	35	15.2	50	107	0	107	(57)
2062	35	15.3	50	108	0	108	(57)
2063	35	15.3	50	108	0	108	(58)
2064	35	15.3	50	108	0	108	(58)
2065	35	15.4	51	108	0	108	(58)
2066	35	15.4	51	109	0	109	(58)
2067	35	15.4	51	109	0	109	(58)
2068	35	15.5	51	109	0	109	(58)
2069	35	15.5	51	109	0	109	(58)
2070	36	15.6	51	110	0	110	(58)

3.2 Utility Water Conservation Plan Goals – Total GPCD

Table 3-2 shows how El Campo's quantified savings from its implemented activities compare with 5- and 10-year goals established in its individual water conservation plan submitted to the TWDB. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Total GPCD Goals – Total GPCD goals start with the utility's baseline[12] for total GPCD and progress in subsequent years to match 5- and 10-year goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Annual Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline total GPCD – target total GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings for All Current Quantified Activities (MG) – Total quantified savings for all current conservation activities and savings from water loss reduction. Refer to Tables 5-1 and 5-2 for details on these savings.

Over (Short) – The amount that the utility's total quantified savings for all current conservation activities (since 2012), including water loss reduction, is over or below the volume represented by reductions in GPCD each year. If the quantified savings are less than these target volumes, the value will appear in parentheses.

Table 3-2. Utility Water Conservation Plan Goals — Total GPCD.

Year #	Year	Utility Population	Total GPCD Goals	Annual Savings Goal with Reduction in GPCD (MG)	Total Savings for All Current Quantified Activities (MG)	Over (Short) (MG)
0	**Baseline**	-	153	0	0	0
1	2015	12,084	146	29	45	16
2	2016	12,089	140	58	45	(13)
3	2017	12,095	133	87	45	(42)
4	2018	12,100	127	117	45	(71)
5-year Goal	2019	12,106	120	146	45	(101)
6	2020	12,111	119	149	45	(104)
7	2021	12,168	118	154	45	(108)
8	2022	12,224	118	158	46	(112)
9	2023	12,281	117	162	46	(117)
10-year Goal	2024	12,337	116	167	46	(121)

[12] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for total GPCD from the utility's most recently submitted five-year water conservation plan was used.

3.3 Utility Water Conservation Plan Goals – Water Loss GPCD

Table 3-3 shows how El Campo's most recent water loss audit compares with 5- and 10-year water loss goals in its water conservation plan. The following definitions pair with the column headers in Table 3-2.

Utility Population – Estimated utility service area population for the years indicated.

Water Loss GPCD Goals – Water loss GPCD goals start with the utility's baseline[13] for water loss GPCD and progress in subsequent years to match 5- and 10-year water loss goals indicated in a utility's five-year water conservation plan on file with the TWDB. The first five annual GPCD goals were developed by spreading the difference between the baseline and five-year goal evenly over five years. The second five annual GPCD goals spread the difference between the five-year goal and 10-year goal evenly over the next five years.

Yearly Savings Goal with Reduction in GPCD (MG) – This column shows what reductions from the baseline water loss GPCD would yield in terms of volume each year as more water is saved. The volumes indicated here are what target water loss GPCD goals look like expressed in million gallons. Annual volumes were derived using the formula: (baseline water loss GPCD – target water loss GPCD for that year) x 365 days ÷ 1,000,000 gallons.

Total Savings from Water Loss Reduction (MG) – The difference between a utility's established baseline for water loss GPCD and the most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB. If water loss GPCD has increased from the utility's baseline to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount. Reference Table 5-2 for savings from water loss reduction.

Over (Short) – The amount that the utility's total savings from water loss reduction is over or below the volume represented by reductions in GPCD each year. If water loss reduction savings are less than these target volumes, the value will appear in parentheses.

Table 3-3. Utility Water Conservation Plan Goals — Water Loss GPCD.

Year #	Year	Utility Population	Water Loss GPCD Goals	Yearly Savings Goal with Reduction in GPCD (MG)	Total Savings from Water Loss Reduction (MG)	Over (Short) (MG)
0	**Baseline**	-	16.00	0	0	0
1	2015	12,084	18.00	(9)	13.2	22
2	2016	12,089	20.00	(18)	13.2	31
3	2017	12,095	22.00	(26)	13.2	40
4	2018	12,100	24.00	(35)	13.2	49
5-year Goal	2019	12,106	26.00	(44)	13.3	57
6	2020	12,111	24.40	(37)	13.3	50
7	2021	12,168	22.80	(30)	13.3	44
8	2022	12,224	21.20	(23)	13.4	37
9	2023	12,281	19.60	(16)	13.4	30
10-year Goal	2024	12,337	18.00	(9)	13.5	23

[13] In the absence of having a baseline figure provided by the TWDB or utility staff, the historic five-year average for water loss GPCD from the utility's most recently submitted five-year water conservation plan was used.

4 Implemented Activities

Below is a list of completed activities with estimated water savings. Note that drought response and other measures are not included in the utility's water savings because they are temporary, awareness-based or not able to be accurately quantified on an annual basis.

These are not savings projections of potential future activities. Estimated savings are based on measures that have actually been implemented. If savings are shown to persist in future years, it is because the measure is permanent, such as an ordinance, or the savings are assumed to continue for the reason listed under the itemized activity. Estimated savings from water rate increases are the one exception to these conditions.

Water Rate Increases

Savings from water rate increases were included because entities such as the U.S. Environmental Protection Agency and others indicate specific savings for utilities that raise rates (Texas Water Development Board, 2013; U.S. E.P.A., 1998; Whitcomb, 1999). This project includes surveys of several utilities that have minimal education efforts, perform no other substantive conservation activities, and yet experienced significant demand reduction that coincided with rate increases. In those cases, savings estimates matched up closely with decreases in total GPCD. For many smaller utilities, especially those with customers lacking disposable income, this measure is the only tool used to conserve other than water loss reduction.

The following assumptions were made for water rate increases:

- The model assumes that savings persist into future years because it is expected that the utility will continue to make periodic rate increases in line with the percentage increases from previous years.
- Only the last two rate increases for a utility were quantified.
- Savings grow with demand because as new customers enter the service area, they are assumed to adhere to the same price elasticity model estimates.
- A weighted average for savings was used when rate increases differed between residential and industrial-commercial-institutional (ICI) customers based on the individual utility's customer class breakdown.
- When a utility raised rates using tiered rate conservation pricing, a 50/50 savings split was used when increases differed between base and volumetric rates.
    - The reasoning is that all customers must react to the base increase, yet the pricing signal is stronger when volumetric rate increases affect the higher usage customers.
    - The 50/50 split is reasonable because many customers will not reach the higher volumetric tiers.
    - Studies show that most customers do not actually know they have reached the higher volumetric tiers; just that their bill has increased (Texas Water Development Board, 2013).

4.1 Itemized Activities

1. **Utility Website**
   a. Easy-to-use website with conservation tips and water rates
   b. Features contact information for Public Works staff and customer service

2. **Continuing Public Education**
   a. The utility engages the public in many ways including:
      i. Brochures, bill messages, displays, and exhibits

3. **Water Loss Reduction Savings**[14]
   a. Savings of 13.23 MG annually in 2015
   b. Water loss reduction savings = the difference between a utility's baseline[15] water loss GPCD submitted in its most recent 5-year water conservation plan and its most recent water loss GPCD reported in the 2015 water loss audit on file with TWDB
   c. If water loss GPCD has increased from the utility's baseline or historic 5-year average to its reported 2015 water loss audit level, then this value will appear negative because more water is being lost than the baseline amount.
   d. All savings estimates grow each year at the same rate population figures for the utility grow in the regional water plan.

4. **Water Rate Increase**
   a. Last rate increase:[16]
      i. 15.0% increase in 2014
   b. Estimated customer demand reduction of 3.0%
   c. Savings is cumulative and based on more than one source[17] (U.S. EPA, 1998; Whitcomb, 1999)
   d. Savings from rate increases are shown to persist over time, however, note that savings from these pricing signals will likely decrease if rates remain the same in future years.

[14] If current water loss levels exceed a utility's baseline, this value is treated as a deduction from total quantified savings.
[15] In the absence of having a baseline figure provided in the utility's most recently submitted 5-year water conservation plan, the historic 5-year average for water loss GPCD in the plan was used.
[16] Correspondence with utility staff.
[17] The study estimates a 2% demand reduction with 10% increase in price on a targeted customer class. By applying a ratio, it is possible to determine the savings for lower or higher percentage increases.

5 Summary of Savings

Table 5-1. Savings by Water Conservation Activity (MG).

Year	Water Rate Increases	TOTAL SAVINGS
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	2.9	3
2015	31.8	32
2016	31.8	32
2017	31.9	32
2018	32.0	32
2019	32.0	32
2020	32.1	32
2021	32.2	32
2022	32.2	32
2023	32.3	32
2024	32.4	32
2025	32.4	32
2026	32.5	32
2027	32.6	33
2028	32.6	33
2029	32.7	33
2030	32.8	33
2031	32.8	33
2032	32.9	33
2033	32.9	33
2034	33.0	33
2035	33.0	33
2036	33.1	33
2037	33.1	33
2038	33.2	33
2039	33.2	33
2040	33.3	33
2041	33.3	33
2042	33.4	33
2043	33.5	33
2044	33.5	34
2045	33.6	34
2046	33.7	34
2047	33.7	34
2048	33.8	34
2049	33.9	34
2050	33.9	34
2051	34.0	34
2052	34.1	34
2053	34.2	34
2054	34.3	34
2055	34.3	34
2056	34.4	34
2057	34.5	35
2058	34.6	35
2059	34.7	35
2060	34.8	35
2061	34.8	35
2062	34.9	35
2063	35.0	35
2064	35.1	35
2065	35.2	35
2066	35.2	35
2067	35.3	35
2068	35.4	35
2069	35.5	35
2070	35.6	36

Table 5-2. Savings from Water Loss Reduction (MG).

Year	Utility Population	Water Loss GPCD	Total Savings from Water Loss Reduction
Baseline	-	16.00	0
2015	12,084	13.00	13.24
2016	12,089	13.00	13.24
2017	12,095	13.00	13.24
2018	12,100	13.00	13.25
2019	12,106	13.00	13.26
2020	12,111	13.00	13.26
2021	12,168	13.00	13.32
2022	12,224	13.00	13.39
2023	12,281	13.00	13.45
2024	12,337	13.00	13.51

6 Suggested Activities

Up to four activities were chosen as potential suggested activities for individual reports. These activities are: AMI system with customer portal, twice-per-week (or less) outdoor watering ordinances, strategic water rate increases, and rain barrels.

Activities were chosen because they are:

- Achievable
- Prevalence of vendors that can actually implement them
- Acceptability to city councils, MUD boards, et al.
- Easily adopted
- Cost effective
- Yield high savings relative to cost

AMI systems with customer engagement portals were also chosen because they represent a profusion of future applications that will undoubtedly continue to advance conservation efforts. AMI and meter data management (MDM) companies are developing new and innovative ways to benefit water providers, customers, and ultimately states that are pushing conservation and usage analytics further.

Each utility should be cognizant of the potential impact that these suggested activities may have on its own unique rate and revenue situation.

Benefits to consider:

- Avoided water supply and wastewater costs
    - The higher water purchase, transmission, and distribution costs are, the greater the potential benefit realized when large amounts of water are conserved with these activities.
- Avoided system expansion costs

- Conserving water may allow a utility to postpone building new system capacity by decreasing demand even as population grows.

Costs to consider:

- Staff time and resources
- Unit cost per unit saved
- Implementation costs
- Stakeholder agreement and support
- Other overhead and budget considerations

6.1 Suggested Activities with Savings Estimates

1. Advanced Metering Infrastructure with Customer Engagement Portal

These portals, along with mobile applications and billing statements, can provide customers with much more access to their water use data in simple and compelling formats. This access and comparison with other customers' usage can reduce water use through changed behavior, as well as provide an opportunity for other conservation programs to be offered to the customer for increased adoption and additional savings. AMI systems support leak notification and web portals with real-time data. Any water loss reduction savings that these systems also yield were included in the water loss assessment of individual reports for this project.

a. Specific utility results will vary based on portal features and frequency of customer notifications.
b. Potential savings estimate assumes 20% of residential customers will use and save water due to the portal (Westin Engineering, 2015)
c. Estimate assumes customers will save 10% of total annual use due to the portal
    i. Savings estimate of 10% is an average of results from multiple studies (Chesnutt and Mitchell, 2013; East Bay Municipal Utility District, 2014; IBM, 2011; Texas A&M and Texas Water Resources Institute, 2016; Westin Engineering, 2015)
d. Residential customers' use assumed to make up approximately 67% of all retail customers' use based on utility profile information submitted to the TWDB
    i. This was the most common percentage of residential use among participating utilities in this project.
    ii. Actual customer class demand percentages will vary by utility.
e. 20% of residential customers saving 10% with this customer class breakdown amounts to 1.34% of total demand
f. Savings are assumed to increase along with demand as connections increase each year.[18]

[18] The 10% consumption reduction figure for 20% of residential customers is conservative, but savings could be greater when monitored yearly as customer engagement increases.

g. See Table 6-1 for potential savings from this measure compared with the utility's WMS supply volumes targets.

Table 6-1. Current Savings + Potential Savings from AMI with Customer Portal (MG).

Year	Actual Current Conservation Activity Savings	Actual Water Loss Reduction Savings (as of 2015)	Total Savings from All Conservation Activity	Potential Savings from AMI with Customer Portal	Conservation WMS Volume	Water Loss Reduction WMS Volume	Total Yearly WMS Volume	Over (Short)
2016	32	13	45	10	20	0	20	35
2017	32	13	45	10	20	0	20	35
2018	32	13	45	10	24	0	24	31
2019	32	13	45	10	28	0	28	28
2020	32	13	45	10	36	0	36	20
2021	32	13	45	10	38	0	38	18
2022	32	13	46	10	39	0	39	16
2023	32	13	46	10	41	0	41	14
2024	32	14	46	10	43	0	43	12
2025	32	14	46	10	45	0	45	11
2026	32	14	46	10	47	0	47	9
2027	33	14	46	10	49	0	49	7
2028	33	14	46	10	51	0	51	5
2029	33	14	47	10	53	0	53	3
2030	33	14	47	10	55	0	55	1
2031	33	14	47	10	58	0	58	(1)
2032	33	14	47	10	60	0	60	(3)
2033	33	14	47	10	62	0	62	(5)
2034	33	14	47	10	64	0	64	(7)
2035	33	14	47	10	66	0	66	(9)
2036	33	14	47	10	69	0	69	(11)
2037	33	14	47	10	71	0	71	(13)
2038	33	14	47	10	73	0	73	(15)
2039	33	14	48	10	75	0	75	(17)
2040	33	14	48	10	77	0	77	(19)

Intentionally Left Blank

Appendix F - References

References

A&N Technical Services, Inc. 2005. BMP Costs & Savings Study: A Guide to the Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices. Prepared for California Urban Water Conservation Council. Section 2.

Austin Water. 2016. Austin Water Conservation Digests. Developed by Austin Water staff.

AWWA Research Foundation. 1999. Residential End Water Uses.

BBC Research and Consulting. 2012. Water Conservation Savings Quantification Study. Prepared for Texas Water Development Board.

California Urban Water Conservation Council. 2004. A Report on Potential Best Management Practices. Prepared for the California Urban Water Conservation Council by Koeller and Company.

Chesnutt, T.W. and D. Mitchell. 2013. Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Reports. Prepared for California Water Foundation and East Bay Muncipal Utility District.

City of Dallas Water Utilities. 2016. City of Dallas: Water Conservation Five-year Work Plan. Developed by Dallas Water Utilities staff.

East Bay Municipal Utility District. 2014. Presentation to Finance Administration Committee: Advanced Metering Infrastructure Pilot Studies Update.

El Paso Water. April 13, 2017. Presentation to Texas Water Development Board: Conservation Program.

Frontier Associates. 2015. WaterWise Evaluation for Resource Action Programs. WaterWise Report.

GDS Associates, Inc. 2002. Quantifying the Effectiveness of Various Water Conservation Techniques in Texas. Prepared for Texas Water Development Board.

Goedrich, Kurt. 2016. Save Water Co. Texas Data.

Hermitte, S.M. and R. Mace. 2012. The Grass is Always Greener… Outdoor Residential Water Use in Texas. Texas Water Development Board Technical Note 12-01.

IBM Research. 2011. Smart Water Pilot Study Report. Water Savings Results.

San Antonio Water System. 2016. Conservation Program Summaries: 2010 – 2015. Developed by San Antonio Water System staff.

SBW Consulting, Inc. 2007. Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-rinse Spray Valve Installation Program (Phase 2). Submitted to California Public Utilities Commission.

Sierra Club-Lone Star Chapter and National Wildlife Federation. 2015. Water Conservation by the Yard: Estimating Savings from Outdoor Watering Restrictions. Texas Living Waters Project.

Texas Water Development Board. 2012. Guidance and Methodology for Reporting on Water Conservation and Water Use. Developed by Texas Water Development Board and Texas Commission on Environmental Quality in consultation with Water Conservation Advisory Council.

Texas Water Development Board. Revised 2013. Water Conservation Best Management Practices: Best Management Practices for Municipal Water Users. TWDB Report 362.

Texas Water Development Board. Revised 2013a. Water Conservation Best Management Practices: Best Management Practices for Wholesale Water Providers. TWDB Report 362.

Texas Water Development Board. 2016. 2016 Panhandle Water Plan. Prepared for Panhandle Water Planning Group.

Texas Water Development Board. 2016a. 2016 Region B Regional Water Plan. Prepared for Region B Water Planning Group.

Texas Water Development Board. 2016b. 2016 Region C Water Plan. Prepared for Region C Water Planning Group.

Texas Water Development Board. 2016c. 2016 Region D Regional Water Plan. Prepared for The North East Texas Regional Water Planning Group.

Texas Water Development Board. 2016d. 2016 Far West Texas Water Plan. Prepared by Far West Texas Water Planning Group.

Texas Water Development Board. 2016e. 2016 Region F Water Plan. Prepared for Region F Water Planning Group.

Texas Water Development Board. 2016f. 2016 Brazos G Regional Water Plan. Prepared for Brazos G Water Planning Group.

Texas Water Development Board. 2016g. 2016 Regional Water Plan. Prepared by Region H Water Planning Group.

Texas Water Development Board. 2016h. 2016 Plateau Region Water Plan. Prepared by Plateau Region Water Planning Group.

Texas Water Development Board. 2016i. 2016 Region K Water Plan. Prepared by Lower Colorado Regional Water Planning Group.

Texas Water Development Board. 2016j. 2016 South Central Texas Regional Water Plan. Prepared by South Central Texas Regional Water Planning Group.

Texas Water Development Board. 2016k. 2016 Rio Grande Regional Water Plan. Prepared by Rio Grande Regional Water Planning Group.

Texas Water Development Board. 2016l. 2016 Coastal Bend Regional Water Plan. Prepared by Coastal Bend Regional Water Planning Group.

Texas Water Development Board. 2016m. 2016 Llano Estacado Regional Water Plan. Prepared by Llano Estacado Regional Water Planning Group.

Texas Water Development Board. 2016n. 2016 Lavaca Regional Water Plan. Prepared by Lavaca Regional Water Planning Group.

Texas Water Development Board. 2016o. Water Conservation Plan Annual Report ~ Retail Water Supplier. TWDB Form No. 1966.

Texas Water Development Board. 2017. Water for Texas: 2017 State Water Plan. Accessed June 20, 2017. http://www.twdb.texas.gov/waterplanning/swp/2017/doc/SWP17-Water-for-Texas.pdf.

Texas A&M AgriLife Research Extension and Texas Water Resources Institute. 2016. Presentation: Continued Development, Research, and Commercialization of a Web-based Portal Using AMI Data.

The High Efficiency Laundry Metering & Marketing Analysis. 1997. THELMA Impact Analysis for EPRI Retail Market Tools and Services. Prepared by SBW Consulting, National Center for Appropriate Technology, et al.

United States Environmental Protection Agency. 1998. WaterSense: Water Conservation Plan Guidelines. Appendix B.

United States Environmental Protection Agency. 2017. WaterSense: Water Budget Tool. Downloaded January 20, 2017. https://www.epa.gov/watersense/water-budget-tool.

Westin Engineering, Inc. 2015. AMI Business Case. Prepared for City of Santa Barbara.

Whitcomb, J. 1999. Water Price Elasticities for Single-family Homes in Texas. Prepared for Texas Water Development Board.

Whitcomb, J.B. 2000. Residential Water Survey Evaluation. Prepared for Contra Costa Water District.